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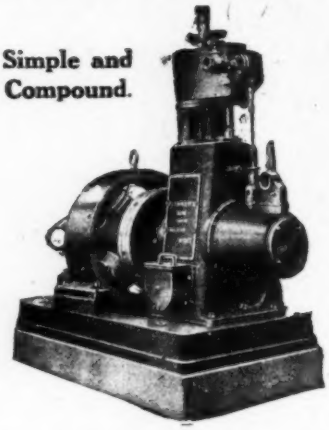

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VOL. LXXXIV. JUNE 13, 1919. No. 2,168.

ELECTRICAL REVIEW.

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OUR TRADE WITH BRAZIL.

THE reception given by the City of London last week to the President of Brazil, Dr. Pessoa, was a very happy event. Now that we are beginning to settle down to the cultivation of Peaceful international relations and interests, we hope that opportunity will arise for showing appropriate hospitality to many eminent guests from distant fields of commercial activity. For years before the war most of the manufacturing nations were casting fond and affectionate export glances across the seas to the vast undeveloped territories and resources of South America. Our own share of Brazilian business was large, but it was, comparatively speaking, a small fraction of what we desired it to be. The United States, busy as it was with its own internal requirements and developments, found time, money, and men, for investigating and cultivating the varied markets of Brazil, Argentina, Chile and Peru, and so on, but its geographical situation, involving shipping operations, was not greatly to its advantage in comparison with ourselves. The railway journey across the border to the north was a simple matter in exploiting American interests in Canada. In the South it was different. Furthermore, we always had more or less close and happy and intimate financial, railway and trading connections with South America, and our outlook up to a few years before the war was good, though the characteristic penetrative machinations of German organisations were not without an adverse effect. Brazil, with her expansive territories, always has possessed attractions for British financiers and traders, and it is unlikely that having sided with us in defeating the military ambitions of Central Europe, she will be unmindful of the past, or will fail to appreciate the difference of ideal that dominates the mind of the Briton and the Teuton. Ever since our early mariners and pioneers went down to the sea in ships in pursuit of trading ventures of exchange with almost unknown lands, we have had a natural instinct for assisting in the development of the resources of the world. That is how Britain became both a trading and a colonising power, and long years of experience in close friendship with other peoples have fitted us for aiding in the development of South American countries to-day, for their good and for our own—development which is in arrears by five years because Germany and her associates chose to hold up, by process of disorganisation, practically the entire peaceful operations of the civilised world. When the President of the Board of Trade remarked that Brazil was one of the countries of the world which was complementary to countries such as our own, he was saying nothing more than the simple truth. Brazil is complementary to this country to-day, as Sir Auckland Geddes said, because she possesses in abundance those things which we need and do not possess in abundance now, but also because, in an industrial manufacturing sense, we possess those things which Brazil earnestly wants as a means of securing her development. "We believe it is well for all things that all should be prosperous," and if we desire to see, not only a resumption of that great trading activity which existed between us in pre-war days, but a vast extension of it, so that Brazil may proceed without further hindrance upon that course of grand progressive development, it is not unreasonable to hope that those in responsible positions in Brazil will be impressed

with the enormous increase that we have made in our manufacturing capacity equipping us for rendering suitable service. In due time no doubt this old country of ours will rise above its present difficulties; but it will obtain some assistance to that end if Allies such as Brazil, who know what we have been through, and have opportunities in the course of their own development for turning trade in this direction, will lend us Allied co-operation. The speech of Dr. Pessoa was couched in the happiest of terms. He was not unmindful that the pleasant relations that united the two countries were of no recent origin—indeed, they dated back "to the very first phase of Brazil's experience as a free people." In our British enterprises, searching out new fields for commerce, for industry, and for navigation there was "cordiality, mutual confidence and friendship." We would rather have this reputation than be remembered by schemes of conscienceless penetration and objectionable aggression, which even "married into the family" so as to make a good Teutonic business connection. Dr. Pessoa recognises that after the formidable struggle Britain is suffering from "fatigues," but he also recognises from the gathering at the Mansion House that we are preparing for a new campaign with our characteristic ardour and tenacity. He has a clear impression of our "abilities and our force," and he wishes to leave behind him an assurance that Brazil does not forget the great share that England had in her economic evolution "by supplying the means for founding of banks, for the construction of railways, for the improvement of our ports, and for every other sort of enterprise in our country." She will rejoice, he says, in seeing England taking her part again in the commercial competition, and in using her capital, her energy, and her intelligence, in the vast field that Brazil has to offer. He also assures us that during his period of Government he will make a point of furthering and protecting all initiative to this end. We believe that these assurances will be read with great acceptance by the leaders of our great electrical and engineering industries, and that in consequence they will go forward more heartily with whatever measures they may have on foot for securing a prosperous interchange with the Brazilian market in the coming years, when we shall depend so much upon exportation for recovering positions lost to us temporarily during the period of the war.

The I.M.E.A. Convention.

This year the Annual Convention of the Incorporated Municipal Electrical Association will be held at Felixstowe under pre-war conditions, so far as they can be realised. The members will meet on Wednesday next at Ipswich, under the presidency of Mr. F. Ayton, electrical engineer and tramway manager to the City, and now chairman of the Electric Vehicle Committee, which owes so much to his admirable work as hon. secretary; the Mayor will welcome the Association, and will entertain the members at afternoon tea, when the official programme of meetings and visits to works has been completed. On Thursday and Friday the meetings will be held at Felixstowe, and visits to war vessels and the Air Station are included in the programme—for the first time. A meeting of special interest is one restricted to "Committee" members of the Association, "to consider the question of the salaries of chief electrical engineers of municipal electric supply undertakings in the light of the applications that have lately been put forward by the Associated Municipal Electrical Engineers (Great Britain and Ireland)," a body which has grown out of the better known Association of Municipal Electrical Engineers of Greater London. We note that this meeting is to be held "After Dinner," and we hope that the mellowing influence of that repast will promote a benevolent disposition on the part of the Councillors, in order that the questions at issue may be solved amicably, and the Felixstowe Convention, which promises otherwise to be a most enjoyable function, may be marked by the cordial recognition on the part of the Committee members of the fact that the Engineer members are the brains of their respective undertakings, and as such are entitled to an adequate reward.

The I.E.E. Dinner and Conversazione.

After four years of war-time conditions, the Institution of Electrical Engineers this year resumes the annual dinner and conversazione, two functions which are looked forward to with keen anticipation by all who are fortunate enough to be able to attend them. On these occasions members foregather from all parts of the country, and renew old acquaintance under the happiest conditions. Many, alas! have passed on to another sphere; they will be sadly missed—but they leave behind the record of life's work accomplished, may we say with all reverence, with 100 per cent. efficiency—a record of which an engineer may well be proud. Such men are not to be mourned; they gave their lives, and it is for us, who bear their loss, to rejoice in their triumph over material things, and for ever to keep their memory green.

We are glad to see that the procedure which distinguishes the I.E.E. dinner from all other social functions of the kind, by restricting the speech-making to 50 minutes and providing opportunity for reunion, is again to be followed, and we anticipate an assembly even greater in numbers than the large gatherings of the past. The conversazione is very appropriately designed "to meet the Members of the Institution who have served in H.M. Forces during the War," who may count upon the heartiest of welcomes; but will those who have been demobilised or disembodied—a large proportion of the total—be permitted to wear their uniforms? We fear they will not, unless special steps are taken to obtain the sanction of the authorities, and we venture to press upon the Council the urgent necessity of taking immediate action to this end. Otherwise much of the interest of the occasion will be lost, and neither those who have served, nor those who are still serving, will be quite at ease, while others will fail to realise the extraordinary proportion of the membership which has taken part in the war—no fewer than 2,000 out of 7,000. In normal times the privilege of wearing uniform might not unreasonably be jealously guarded, but the times have changed; the Empire has raised 8 million soldiers and sailors, a citizen army of the highest quality, whose achievements have thrilled the world, and these men are justly entitled to wear their uniform at public functions—above all, at a function specifically devoted to their official reception by the professional Institution which is proud to claim them as her sons. Surely there could be no more appropriate occasion for the wearing of the uniform, and we trust that the authorities will recognise the fact.

[Whilst going to press we learn that officers will be permitted to wear uniform; but the privilege ought to apply equally to N.C.O.'s and men.]

Miners, the Community and Industry.

The proceedings of the Coal Commission are undoubtedly interesting, but they are not more interesting than they are important. The extreme element in Labour is having an opportunity to show openly the workings of its mind, but inasmuch as the inquiry cannot be fairly conducted without both sides being heard, the pros and cons of nationalisation are also being put forward by men of experience who recognise how easy it would be to endanger the whole industrial and economic system by the adoption of a reckless policy toward any one section of interests. What is happening in certain other countries at the present time ought to be an object lesson showing the lamentable consequences which upheaval may bring to whole nations, in which the working-class element naturally forms a considerable part. We are far from disapproving of efforts which strike at injustices to those engaged in industrial operations—whether in coal-mining, in chain-making, match-making, or in the clothing trades, but we are quite unconvinced that it is only through nationalisation that remedies can be introduced or enforced. We certainly are not convinced that the cost of coal to industry or to the millions of rationed coal consumers is likely to be reduced so long as Labour can secure whatever wage it pleases to ask, or can reduce its output as the mood inclines it. If experience of nationalisation in other departments had proved that the cost of a commodity or a service had been reduced, or that the efficiency of service given had been improved,

because the hand of private control and enterprise had been removed, objections to national ownership and operation might be lessened, but without anticipating in any way the result of this inquiry, we may say that there is little hope of securing cheaper coal and higher efficiency of equipment and working of our collieries, by dispensing with the existing ownership and substituting State-ownership. As witness after witness has appeared, it has been obvious that the public have good reason to fear that both they as private consumers, and the fuel-using industries in which they gain their livelihood, will have to pay more even beyond the present prohibitive price per ton, if all sorts of burdens are to be added in the interests of already well-paid labour, and if the profits of coal-owners and middlemen are not fairly controlled. We should have supposed that few things were more important in the present critical industrial situation than that fuel should be plentiful and cheap for industry, and that the expenses of the householder—for whom the cost of living remains unconscionably high—should be reduced. Diatribes against any class of men, especially in these days, are not to our liking, but our own impression is that there are few better examples of the rank selfishness of organised labour than is this of the miners, who, unrationed, can burn as much coal as they like, while the private and industrial consumer, and the public power and lighting services, must be rationed, and must pay through the nose for the limited supplies which they are privileged to receive. What does it matter to the miner who shivers, as long as he and his can be warm through the winter months? Does he care how other industries are hampered and other industrial workers' interests are consequently jeopardised, so long as the coal-getter works less and receives more? Talk about the solidarity of the human race—the interests that are common to us all—do not the best interests of the whole nation during the coming critical days lie along the path of industrial prosperity? How can the machinery of economic life run smoothly if we deliberately put all this grit into its parts? In our opinion, little of the evidence given before the Commission has been of such immediate importance as that of Mr. Walter Leaf, chairman of the Committee of London Clearing Bankers, and chairman of electricity supply companies. He said that if nationalisation were to be carried out, the two essential conditions which must be fulfilled, if no great damage were to be done to industry in general, were (1) that there should be a reasonable prospect that it would result at least in not less efficient production than at present, ensuring a cost to other industries for coal at least as low as that at which it could be produced under private ownership; (2) that existing interests should be purchased by the State at a price which would appear equitable in the view of the average fair-minded man. Any confiscation of any interests without fair compensation would be a shock to public confidence, which would absolutely paralyse all industrial enterprise. Mr. Leaf expressed the views of the City when he said that the export of coal should as soon as possible be raised to the highest possible level. In order to resume our international trade it was absolutely essential that the exchanges should be put on a proper basis, and this could only be done by exporting. Coal, he said, was at once among the greatest of our exports and the one which could at once be exported without delays arising from the adaptation of war machinery. "It is to this article of commerce that we mainly look at the moment to restore the foreign exchange to parity. Until this is done, our manufacturers must be at a great disadvantage wherever they have to import their raw material." We wonder whether the miners or their spokesmen have ever given thought to the part that they may play in restoring the foreign exchanges, than which there are few more serious problems at the moment. From the statement made by Sir Auckland Geddes concerning the necessity for restricting our coal export by many millions of tons per annum owing to the miners' decreased output in the early months of this year, it is not possible to give Mr. Leaf and the City authorities much satisfaction. The possible further increase in the cost per ton of coal used by industry is also most disquieting. Industry, as time goes on, will depend more and more upon electricity, either under the Government Commissioners or the hydro-electric developments which are projected, and possibly the oil discovery may have a considerable influence. Further, the householder will with greater expedition adopt electricity for heating and other domestic purposes. These things are all to the good, or will be, in the long run. But *at this moment* the international position requires from the miner the best work that he can do, and general industry requires a bigger output from him at a reasonable figure to assist in the return of men and women to employment. Would that some voice from Heaven would make it plain that the interests of all of us are so delicately interwoven that at such a juncture as this, when foreign traders are so alert to profit by our disadvantages, no one section can selfishly press extravagant claims upon the rest, or unreasonably limit its own productivity, without the whole community suffering.

The Industrial League.

On Tuesday, last week, with our *confrères* of the Technical Press, we had the pleasure of hearing from the Right Hon. G. H. Roberts, M.P., president of the Industrial League, and Mr. H. E. Blain, vice-president, interesting particulars regarding the objects of the League and the methods by which it aims to promote harmonious co-operation between employers and employed. We were, of course, already familiar with the tenets of the League, which has been admirably described by the Right Hon. J. R. Clynes—himself, like Mr. Roberts, a Labour leader—as "an instrument for widening toleration, and for effecting a more complete understanding of recurring difference and rival interests"; and we wish to bring it more prominently before our readers, as an Institution which merits their whole-hearted approval and support. It was established in 1915 by a few men of imagination and foresight, to deal with some of the problems that were expected to arise out of the war; its unique advantage is that it embraces both parties in the industrial world, and brings them together in friendly discussion, striving at the same time to elevate the status of the worker and "make his life worth living," and to promote the public welfare by instilling the doctrine of increased production, without which nothing of permanent value can be accomplished. The League is out to educate both employers and employed, and to dispel the fog of distrust which in the past has kept them apart. It is about to initiate a vigorous campaign throughout the country, and is convening a three-day Conference in August for thorough discussion of the great questions with which it is concerned. The League has high ideals, and is led by men of action; its aims are wholly commendable from every point of view, and we earnestly exhort our readers to join it and support it in every possible way.

The Price of Electrical Energy.

On October 5th, 1917, and again on July 26th, 1918, we published lists showing the advances that had been made in the charges for electrical energy at a large number of towns in this country, to meet the increasing cost of production due to war conditions. The subject is one of considerable interest to central-station managers, who, with rare exceptions, have been compelled from time to time to revise their tariffs, and naturally desire to know what their *confrères* are doing in the matter.

This year, at the request of the Municipal Electrical Association, we have extended the investigation to cover the various tariffs more fully, giving both pre-war and present prices, and including the cost of coal; in consequence of this, the data have become too unwieldy to be conveniently handled in our columns, and therefore we are producing them in the form of a Table, issued separately from the journal. Complimentary copies of the Table are being forwarded to the engineers to whom we are indebted for the particulars, and to whom we tender our thanks for their kind assistance. Additional copies can be obtained from our Publishing Department, as advertised elsewhere in this issue.

METHODS OF PREVENTING THE TRANSMISSION OF VIBRATIONS IN BUILDINGS.

By A. B. EASON, M.A., A.M.I.E.E.

THIS article discusses various types of isolators which can be placed between vibrating machinery and the floors of buildings, and the effect of altering the intensity of pressure in the isolating supports, due to altering their dimensions.

(*A*) *Isolators for Reducing Vibrations: Anti-Vibrators.*—Consider the use of isolating devices from a theoretical point of view. It is well known that in laboratories, delicate instruments—such as very sensitive mirror galvanometers—are hung on rubber or spring suspensions, so that the vibrations of the walls of the building may not affect the instrument. In general, the more flexible and elastic the suspension—and as a result the slower the natural period of oscillation of the instrument—the less will be the

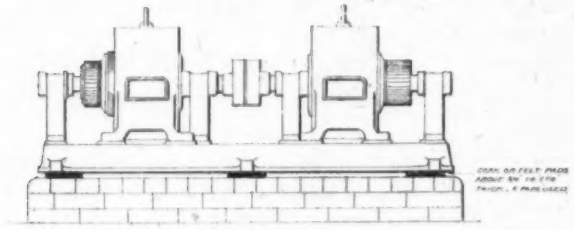
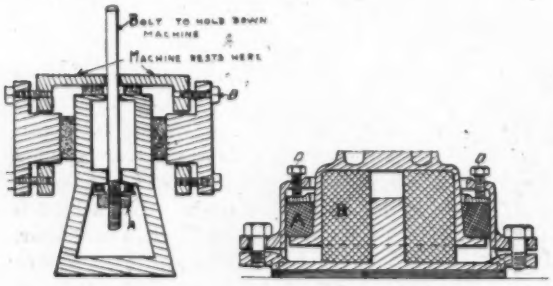


FIG. 1.

effect of external vibrations on the instrument. The converse of this is true; if the source of vibration is the instrument, the effect produced on outside bodies will be reduced if the connecting links, suspensions, or supports are made more elastic.

Notice how this principle is made use of in various forms of isolators. Fig. 1 shows a motor-generator resting on six pads of some composition such as rubber, cork, or mascolite. Such forms of support are relatively very inelastic. Fig. 2 shows Prache's isolator; four or six of these units would be required for a machine of moderate size. It will be seen that the holding-down bolt is not in direct contact with the iron support at any point. The elasticity of the support can be varied by screwing up the bolt A, and the side bolts B. Fig. 3 shows the type of support made to Fritz Gerb's Patent 11,892, of 1910, and 25,436, of 1912, by the Anti-Vibration and Noise Co. W. Christie & Grey, Ltd., now supply these with slightly different adjustments, though the principle is the same.



A and B are cork, felt or rubber.

FIG. 2.—PRACHE'S ISOLATOR. FIG. 3.—GERB'S ANTI-VIBRATOR.

By tightening screws D the load per unit area on the elastic compounds A and B can be increased; the damping due to friction between A and B and the ironwork is then increased. Thus the elasticity and the damping factor are made independent of the load on the support due to the weight of the machine.

Fig. 4 shows an elastic support made of iron: the machine rests on the ends of bar A, which behaves partly as a cantilever; this bar rests on beams B, of flat iron. Both A and B are elastic, and the result of the combination is to prevent the vibration from reaching the brick pier. Fig. 5 shows a similar type of support, only more elaborate; the rubber pads A by themselves were not sufficient to prevent the relatively severe vibrations of the machine from reaching the bed. By placing them on the ends of the cantilevers B, and putting pads C as the fulcra under the cantilevers transmission was prevented. The girder cantilever B simply acts as a spring suspension. The transverse wood beams under pads A were placed on the I beam as a flat support for the rubber pad, which was larger than the I beam. The wood itself had practically no elasticity. The longitudinal wood beam was only used to distribute the pressure over the pier. The tests made on this form of support are reported in the *Post Office Electrical Engineers' Journal*, Vol. 12, page 35, April, 1919.

The use of sand, gravel, lead, and felt as isolators* is not satisfactory, though doubtless in one or two instances such types have cured troublesome vibrations; but the originating vibrations in such cases must have been of little magnitude.

Bousquet (*La Nature*, page 296, 1918) was able to prevent the vibrations due to street traffic from reaching large buildings by placing a layer of cork and resin, 1 metre deep, ½ metre wide, between the footpath and the building.

In Berlin the underground railway is separated from the ground by layers of gravel. (*Naturwissen.* Vol. 5, page 97, 1917). Hall (*Elec. World*, Vol. 60, page 200, 1912) agrees that sharp broken rock, or asbestos and leather, are valuable as isolators under heavy machinery, but suggests that sand is useless. Berger (*Gesundheits Ingr.*, Vol.

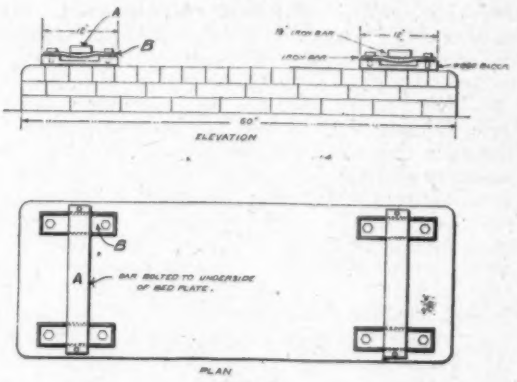


FIG. 4.

36, page 433, 1915) mentions that steel shavings form a useful isolator on account of their strength and elasticity: the vibrations are damped by friction and heat up the steel. Hoffmann states that placing spring beams under a 1,200-KW. A.C. transformer prevented the transmission of objectionable vibration, whereas placing layers of felt, cork, and rubber under the machine had been ineffective.

It is impossible to state which is the best isolator, but to get the best isolating result quickly one should have a form of support which is adjustable as to elasticity, and also, if possible, adjustable as to damping.

(*B*) *Effect of Elasticity of the Support.*—We shall now discuss the effect of the loading of the support, or of altering the intensity of pressure in the isolator. In the supports shown in figs. 2 and 3 the pressure is easily alterable by screw adjustments. In the I beam support, shown in fig. 5, the adjustment is made by altering the position of the fulcra B. Few writers say anything about the best size or thickness of isolator, or the best dimensions of the rubber, cork, or mascolite pads to use. For instance, let a machine weigh 2,304 lb., and be placed on four rubber pads; will it be best to have pads 2, 3, 4, 8 in. sq., with intensity of pressure, p = 144, 64, 36, or 9 lb./in.²? Obviously,

* Davies: ELEC. REV., Vol. 72, page 505, 1915.

p should be less than the crushing load of the material; but, apart from that, what load is suitable? The conditions of the problem are these:—A body of mass M is connected by an elastic support to the foundations W; the foundations have a natural period of oscillation (frequency, n', say); the mass M oscillating on the elastic support has a frequency, n. The frequency of vibration of the motor-generator which will cause resonant vibrations in the system is ordinarily neither n nor n'. The problem to be solved is to make a support of such characteristics that this resonant frequency is not near the frequency of vibration, f, in the machine, which depends on its speed. This assumes that the machine is a fixed-speed machine. To alter the frequency n of mass M on the support, one alters the elasticity of the support, which can be done simply by altering the dimensions of the support. Suppose that the vibration from a machine has been prevented from travelling to the floor by placing cork pads 6 in. square under it, both 4-in. and 8-in. square pads would probably be less-effective isolators. It is probable

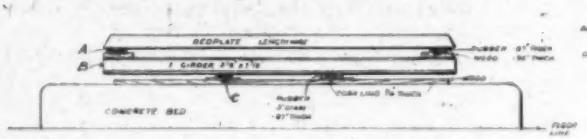


FIG. 5.

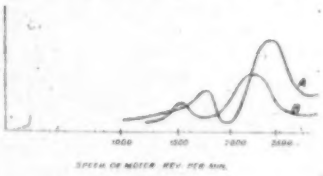


FIG. 6.

that a reduction in the size of pads will usually be more effective in stopping the transmission of vibration than an increase in their area. When one is experimenting with various types of support, one is really altering the frequency n of the machine on its support. The effect upon the amplitude of the floor vibrations is similar to that shown in fig. 6. This shows amplitude plotted against motor speed with a fixed type of support. Curve A was obtained with the motor direct on the floor; curve B was obtained with a pad of mascolite 11 mm. thick interposed between the floor and the motor. Exactly the same types of curve would be obtained if the motor speed was kept constant and different types of support were tested. But the different types of support cannot so easily be represented, as abscissæ, as they vary in material, size, and shape. The curves in fig. 6 are

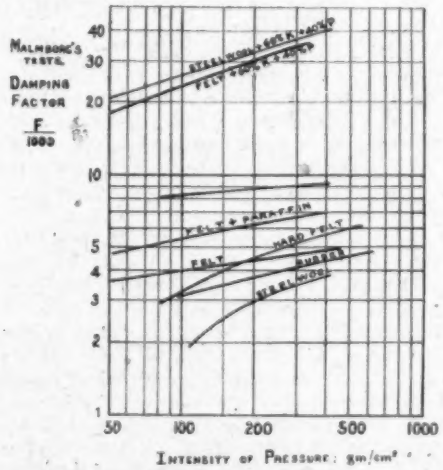


FIG. 7.

taken from Berger's report (*Gesundheits Ingr.*, Vol. 36, p. 433, 1913), from which the following conclusions may be drawn:—The maximum amplitude of vibration of the floor was reduced when isolators were used. (2) The amplitude at any particular motor speed might be less with no isolator than with one. (3) In these tests the smallest amplitude obtainable was 0·02 mm.; this occurred with the motor running at 2,000 R.P.M., and placed directly on the floor. (4) The minima obtainable with isolators was 0·03 mm., and was practically the same, no matter which form of isolator was in use. This minimum occurred at various motor speeds. The types of isolator used were:—Pressed felt, 9·3 and 21 mm. thick; 5 mm. rubber; 11 and 22 mm. mascolite; 9·3, 15, 20, and 40 mm. compressed cork.

Ottenstein (*Elektrotech. Zeit.*, Vol. 32, page 410, 1917) made somewhat similar tests, and came to the same conclusions. He found light porous cork was a satisfactory isolator, but did not recommend its use generally, as it loses its elasticity readily.

In all these tests, the elasticity of the supports plays a decisive part. Malmborg (*Ann. der Phys.*, Vol. 44, p. 337, 1914) has investigated this property of elasticity, and the damping properties of the following isolating materials:—(1) Thick soft felt as used for packing saddles, known as "horse felt"; (2) hard felt used for the soles of shoes; (3) rubber; (4) natural cork: (5) "suberit"; (6) "Gewebebau platte," which probably is the same as mascolite: (7) steel shavings 0·1 mm. thick, of density 0·42 gm. cm.^{3}; (8) felt and lead; (9) felt impregnated with various viscous liquids, water, paraffin oil, resin.

Fig. 7 shows how the damping factor is improved as the intensity of pressure in the isolating material is increased, confirming the advantage of reducing the area of the isolator. Malmborg concludes that the common isolators, cork, felt, &c., are relatively poor dampers; whereas the immersion of felt in a solution of paraffin and resin improved the damping immensely; the difficulty in practice lies in keeping the solution viscous; it tends to harden in the atmosphere.

The general conclusions as to the best isolators are:—

1. The supports should be made as elastic as possible.
2. When different materials are being used for the supports, the hard materials, such as iron, should be placed next the soft ones, such as felt and cork.
3. Layers of widely-different materials are useful.
4. A mere increase of area or thickness may be disadvantageous; the increase of intensity of pressure in the isolator is often advantageous.

Water-power in Sweden.—The three principal hydro-electric power stations belonging to the Government, Trollhätten, Alvkarleby, and Porjus, have been extended and now contain plant capable of an output of 153,500 KW. The energy supplied during the past year amounted to 692,000,000 KW.-hours. The Hemsjö Power Co., Ltd., has increased its power installation from 3,400 KW. in 1911, to 7,860 KW. in 1916, and equipped 68 miles of H.T. transmission lines complete with all necessary transformers and L.T. local lines. The output for the present year was 35,000,000 KW. The total income of the company during the year 1917-18 was £77,500, the average charge being 0.533d. per KW-hour. The actual charge depends upon the distance of transmission and the quantity taken. The present annual income per KW. is £9 17s. 6d. The power factor is 48.7. The Traffic Company Grängesberg-Oxelösund has supplied the power used on the Gällivare Railway, where the section Kiruna-Nathavaara has been electrified. The company's power station in Kiruna has distributed 9,700,000 KW.-hours to the railway line, but almost the whole of this power has been received from the Government power station at Porjus. The output from the company's own stations has been 65,300,000 KW.-hours, and auxiliary steam plant for 7,000 KW. is being erected. The Gällivara Ore mountain is supplied from the Porjus power station, 10,800,000 KW.-hours having been transmitted during the past year. The present high coal prices are favourable for the extension of hydroelectric power works, and the capital invested in such undertakings has during the last year increased from £2,200,000 to £11,100,000, in spite of the many difficulties caused by the war. Large areas of land are being cultivated by electric power and many new chemical and industrial factories are being erected, which, as the railways become electrified, will all require large quantities of electrical energy.—*Teknisk Tidskrift.*

THE ELECTRICITY SUPPLY BILL.

The Bill has now been long enough before the public to enable those more directly concerned in its provisions to form opinions as to its bearing upon their interests, and naturally very varied and conflicting pronouncements are appearing in the Press and in the minutes of Committees and company reports. Apart from the ebullitions of extremists on either side, which are usually based upon superficial impressions as to substance or obvious distortions of fact, the discussion centres mainly round the financial provisions of the Bill, and it appears to be certain that these will require considerable modification before the measure receives the Royal Assent, for the close examination to which they have been subjected has revealed a number of defects of material importance.

The companies' point of view has been ably expressed by Mr. P. D. Tuckett, chairman of the Urban Electric Supply Co., and of the Metropolitan Electric Supply Co., on behalf of the smaller undertakings, and by Mr. J. B. Braithwaite, chairman of three of the London supply companies, on behalf of the larger. Whilst approving of the objects of the Bill, Mr. Tuckett opposes public ownership and operation by District Boards; he welcomes the appointment of a Board of Commissioners, but would have them confine their activities to advisory functions and to those of an impartial expert tribunal. He deprecates the pursuit of vague ideals, which undoubtedly has wrought immense mischief in the past, and points out that the erection of super-stations under State control is not necessarily a short cut to cheap electricity supply. What he defines as the outstanding needs of the industry are freedom from harassing restrictions and political interference, and a fair field for enterprise, and he fears that the Bill whilst removing the existing restrictions will open the door to political interference in an aggravated form. But it is the question of compulsory purchase which chiefly alarms both these gentlemen, on the ground that the terms outlined in the Bill constitute a grave injustice to shareholders. Not only will their undertakings be deprived of the most valuable years of their concessions, and their property be severed in halves, without compensation, but also the purchase price of the plant will take account of depreciation and not of appreciation, contrary to the terms prescribed under the Electric Lighting Act of 1888, which provided for the payment of the "fair market value at the time of the purchase." Moreover, in the case of many small undertakings, the possibility of purchase by the local authority was very remote, whereas the District Boards will be in a much better position to purchase them, and the cost of management, thrown entirely upon the distributing side of the undertaking, will constitute a relatively heavier burden. Both objectors stigmatise the new proposals as a distinct breach of the Parliamentary bargain which was made in 1888, and under which most of the capital has been subscribed.

These, we agree, are not unreasonable arguments; but it seems to us that they take too little account of the safeguards provided in the Bill, and exhibit an unwarranted distrust of the discretion and fairness of the Commissioners. It is expressly stated in the Bill that in the event of disagreement as to the justice of the purchase price, the matter shall be referred to arbitration; the wording of this proviso and of the purchase clauses generally should be widened, so as to cover other points in addition to the cost and depreciation of the generating station alone, which cannot be regarded as separate and distinct from the rest of the undertaking. As regards goodwill, however, it is not so clear that the position of the companies is adversely affected, for goodwill is associated with distribution, and if, as is foreshadowed, the distributors remain in possession, they will retain the goodwill. In this connection, there is certainly justification for complaint if the District Boards, as Mr. Tuckett suggests, are able to come into the distributing area and supply electricity for lighting the streets, railway stations, &c., and this point ought to be satisfactorily settled by amendment of the Bill. As regards the powers of the Commissioners to amend or revoke existing Provisional Orders, we may point out that this can only be done by "Special Orders," which have to be reviewed by the Board of Trade, and, if opposed, to be made the subject of local inquiry; they have also to be laid before Parliament before they can be put in force. It should not, however, be within the power of the Board of Trade arbitrarily to curtail powers granted by Parliament without due compensation, and here also there is room for amendment.

On the municipal side of the debate, the Hammersmith Borough Council demands that public representation shall be assured predominance on the District Boards, and that the Boards shall be allowed to elect their own chairmen; objection is taken to the special representation of Labour as an invidious distinction. While the companies declaim against the injustice of the purchase terms, the Councils demand that their stations shall be purchased on the same basis as those in private ownership! The Hammersmith Council also objects to the lack of a right of appeal from the decisions of the Commissioners, and emphasises the "danger" that a company may be established to carry on a one-time municipal enterprise, with the advantage of starting with a very low capital—the outstanding debt. While we think that provision should be made for appeal or arbitration on any point which may involve a question of financial equity, we do not believe that there is the slightest risk of any company manipulation on the part of the Commissioners which would be detrimental to the public interest.

There is one point which frequently crops up, and which we think is regarded in a wrong light. It is alleged that plant and mains will cost at least twice as much as before the war, and that, therefore, the business of electricity supply will be heavily handicapped. In one sense this is strictly true; but actually it is of no importance. All other costs have gone up in a like ratio, and the situation of electrical undertakings is relatively unchanged; the fact is that the nominal value of the currency has fallen, but the relative values of commodities such as electricity and gas are much the same as before. As a matter of fact, the selling price of electrical energy has not increased so much as that of other commodities, owing to the larger proportion of the cost of electrical energy which is represented by capital charges; in effect, those capital charges have been *halved* by the change in the value of currency, and that is the main reason why the cost of electricity has not been doubled.

At a private gathering last week, Mr. Philip Dawson reviewed the position mainly from the technical point of view, severely criticising the idea which has found favour amongst the public that the Bill will enable the cost of electrical energy to be greatly reduced—a view which every electrical engineer knows to be entirely fallacious. He showed that with a load factor of 50 per cent, the minimum cost of the KW.-hour sent out from the super-station at high pressure would be slightly below ½d., and pointed out that before the war the cost of electrical energy in this country compared very favourably with foreign tariffs; he deprecated the suggestion that the super-station would be a remedy for all evils, though he admitted that there was room for an immense expansion of electricity supply. Stress was laid on the point which we have emphasised on previous occasions—that it was useless to erect big power stations without, at the same time, taking steps to secure adequate outlets for their product. In many respects, however, Mr. Dawson in the course of his speech modified his remarks materially, and, in fact, advocated many of the objects towards which the Bill is expressly directed, such as the co-ordination and amalgamation of existing undertakings, the supply of electricity to railways from stations carrying on general supply, State assistance on commercial lines, the removal of hampering restrictions, &c.; and his address, whilst admirably summarising the position and correcting erroneous ideas that the general public may have formed, contains little to edify the technical man.

In our issue of May 23rd we abstracted at considerable length Mr. Highfield's paper before the Royal Society of Arts; the author dealt with the subject in detail, and, like

Mr. Dawson, pointed out the pressing necessity of the removal of the present uncertainty, in order to enable urgently needed extensions to be carried out. For this purpose he pressed for the immediate appointment of the Electricity Commissioners, leaving the creation of District Boards and the purchase of stations and mains to follow in due course when the more urgent considerations had been disposed of.

(To be continued.)

Mr. Braithwaite's Views.

In a letter to the *Financial Times*, Mr. J. B. Braithwaite said that as chairman of three of the electricity companies supplying London, he thought it well that the public should realise that the Electricity Bill as at present drafted involved a serious breach of faith with the investor. When electricity supply was in its infancy and Parliament was anxious to encourage private capital to undertake the risky work of pioneering the new industry, the Electric Lighting Act of 1888 was passed, giving the companies who received provisional orders under it a 42 years' tenure. This extended tenure was given because, under the Electric Lighting Act of 1882, clause 27, power was taken to purchase the undertaking within six months after the expiration of a period of 21 years, and it was found impossible to raise the necessary capital on these conditions. The purchase of the undertaking by the local authority of the district served was provided for, the terms of purchase being such, first, that where a part only of the undertaking was purchased, as proposed under the Electricity Bill now before Parliament, loss occasioned by severance was to be paid; secondly, that the purchase price was to be the fair market value at the time of the purchase.

The Act as drafted constituted a three-fold breach of the Parliamentary bargain under which the capital of electrical supply undertakings throughout the country had been subscribed: (1) In providing for the purchase of the generating station apart from the distribution system without any compensation for severance. (2) In providing that the actual cost of the generating stations less depreciation should be the purchase price instead of their fair market value at the time of the purchase. (3) By anticipating the date of purchase provided for in the 1888 Act by 12 years without any compensation for the same.

He could not believe that any Government would allow such a gross breach of faith to go through. Now that electric supply was well understood and that the various companies were receiving some return for their early outlay, it would be grossly unjust to deprive them without compensation of the last 12 years of their tenure, which, in the ordinary course of events, would be the most profitable. There was another point so far as the London electricity supply companies were concerned. Under the Act of 1908, which substituted the London County Council for the individual borough councils as the purchasing authority, it was provided that if the London County Council exercised its right of purchase in 1931 it must not buy one company and leave another, but, if it purchased at all, it must purchase the undertakings of all the companies.

Under the present Electricity (Supply) Bill the District Electricity Board was not even bound to buy all the generating stations and transmission lines within its area; a company which had only been granted by Parliament a small area in which to supply electricity, and consequently had a small and relatively uneconomical generating station, might have its district invaded and its business taken away from it without receiving any compensation whatever even on the partial and inequitable terms provided in the Bill.

Mr. Tuckett's Criticism.

At the meeting of the Urban Electric Supply Co., Ltd., on May 21st, the chairman, Mr. P. D. Tuckett, after a general review of the situation, outlined the proposals embodied in the Electricity Supply Bill, and said that so far as it was an attempt to handle the problem on a broad and comprehensive basis, they would all agree that it proceeded on the right lines, for no one questioned the importance of taking all possible steps to encourage the development of a cheap and ample supply of electricity, for which there was still an immense field open; but in providing for public ownership, and still more for operation by District Boards, he feared a grave mistake was being made.

He found it difficult to believe that five supermen, under the control of a Government department, and acting through District Boards constituted on the lines proposed, were likely to handle the complexities of so technical and rapidly growing a business half as successfully as those who had built it up and were already familiar with its many needs and difficulties. The whole industry was prepared to welcome the appointment of an expert Board of Commissioners for co-ordinating and controlling its development, advising Parliament of its needs, and generally promoting its welfare by acting as an informed and impartial tribunal and in other ways, and it had so formally expressed itself. That he conceived to be the proper function of such a board, rather than to undertake the dangerously ambitious experiment of attempting to run the business.

As stated in an admirable pamphlet of Electrical Development issued by the Ministry of Reconstruction, "In the past ill-considered legislation based on vague ideals rather than sure knowledge, has done much to hamper electrical development in this country."

In view of the immensely enlarged importance of electricity at the present time, it would be deplorable if they were again to be condemned to suffer from hasty and ill-considered legislation based on vague ideals rather than sure knowledge; yet that was the danger.

The outstanding needs of the industry were:—

Freedom from the artificial and hampering restrictions from which it had so long suffered, and

A fair field for its enterprise free from the paralysing uncertainties arising from political interference and liability to purchase on uncertain terms.

Whilst going a long way to meet the first of these requirements, the Bill seemed likely to rivet the shackles of political interference tighter than ever.

With extensions of plant called for in every direction, there was urgent need for a settled policy and renewed confidence if the industry was to go forward whole-heartedly with the difficult task which lay before it, for, until its future status was determined and it was assured of fair treatment, it could not be expected to incur the abnormally heavy expenditure which current prices involved.

With regard to the purchase of their stations, he considered the terms suggested as open to the gravest objection. The standard price was to be the cost price, less depreciation. They were to stand to lose where there had been depreciation in value without being given any credit for appreciation in value. Moreover, the expenditure which was to be taken into account in determining the cost price, and the amount of depreciation, were to be settled by the Commissioners, who were in no sense an impartial tribunal, since they had a direct interest in acquiring the stations as cheaply as possible. It seemed altogether opposed to the most elementary principles of justice that the Commissioners should act as judges in their own cause, and yet this objectionable feature recurred all through the Bill.

Then, again, some of their undertakings were not purchaseable for many years. Unless they were to receive compensation therefor, why should they be deprived of their stations now, and so lose the right to the benefit of the increased economies which they expected to derive from the improved plant which they would have erected therein during the remainder of the term?

Again, many of their undertakings were purchaseable by the local authority on the basis of capital expenditure plus a percentage. Why should they have their stations taken away on any less favourable basis?

To have the District Boards substituted for the local authorities as purchasers of their undertakings was a serious variation of the bargain on which they undertook the risk of embarking on the business, since with many of their small undertakings the chance of the local authority exercising its power of purchase was comparatively remote, a factor which constituted a material element in computing the risk.

They would still require competent technical staffs, even if deprived of the stations; in their small undertakings how were they to afford them for distribution alone? And how was it supposed that cheap electricity was going to result from a duplication of staff, the distribution being run by them and the stations by the District Boards? and was not the divided responsibility bound to lead to endless confusion and difficulty?

The District Boards, having deprived them of their stations, were to be allowed to supply lighting authorities, railways, tramways, &c. In some of their towns the public lighting represented a large proportion of the load, and without it they could never have undertaken the obligations of the concession. They derived a substantial revenue from supplying the light and power in railway stations, yards, workshops, &c. In other towns they supplied the tramway load. On no equitable basis was it possible to deprive them of these loads without adequate compensation.

Seeing that their Provisional Orders constituted the Charters under which they worked, it seemed a strong measure to suggest that they might be revoked at the will and pleasure of the Commissioners backed by the Minister of Ways and Communications.

Probably the Bill would receive considerable modification during its passage through Parliament, and he imagined it was more than likely that most of their stations would fall within the category of those which the District Boards might be exempted from acquiring.

Expenditure under the Bill.

A memorandum has been issued as a White Paper showing the expenditure likely to be incurred under the financial clauses of the Electricity (Supply) Bill. Dealing with revenue expenditure, it is stated that the whole of the expenses in connection with the administration of the Bill would ultimately be borne by the District Electricity Boards proposed to be set up, among which the expenses will be apportioned. During the first five years after the passing of the Act the expenses will be paid out of moneys provided by Parliament, but such moneys are to be treated as advances from the Treasury and are to be repaid with interest. It is difficult accurately to forecast this annual expenditure, but the salaries, office and travelling expenses of the Electricity Commissioners, their inspectors, assistants, and staff

should not exceed £35,000 per annum. Under clause 3 the Commissioners, with the approval of the Board of Trade (or the Ministry of Ways and Communications), may cause necessary experiments for the improvement of the methods of electricity supply to be made, and it is thought that the expenditure on this account will not exceed £10,000 a year. This money will be recovered from the industry in the same way, and there will be no permanent charge upon the State.

As to capital expenditure, it is stated that under clause 19 powers are sought for the Board of Trade (or Ministry of Ways and Communications) to expend on urgent works a sum not exceeding £20,000,000. This money is also an advance from the Treasury, and will be repaid, with interest and such charges as the Treasury may require, by the Electricity Boards for the districts concerned when established. It is anticipated that this expenditure will be spread over a period of five years from the passing of the Act, as under:—

Financial year ending April 1st.	Capital expended.
1920	£1,000,000
1921	3,000,000
1922	7,500,000
1923	5,000,000
1924	3,500,000
	£20,000,000

This estimate is based on the known urgent requirements for new generating stations and plant, and is spread over the time necessary to cover the constructional period. It also covers the necessary transmission and inter-connecting cables and lines, having regard to the annual output from and capacity of British cable makers' works.

In clause 33 the Treasury is empowered to guarantee the interest, on such terms as it thinks fit, on stock not exceeding £25,000,000, to be issued by the Electricity Commissioners for the purpose of loans to District Electricity Boards or authorised undertakers where it appears that money necessary for the purposes of the undertakings cannot be otherwise raised on reasonable terms. It is impossible to say in what cases (if any) it will be necessary to call upon this guarantee. The whole scheme is based upon the anticipation that the industry shall be self-supporting, and it is not expected that the guarantee will, in fact, involve the Treasury in any payment, but the provision is regarded as necessary, if only for the purpose of facilitating the issue of such stock as may be found to be required.—*Financial Times.*

INCENTIVES TO EFFICIENCY.

By MAJOR E. A. PELLS, R.E.

The first question any worker will ask as soon as the idea of efficiency methods is brought to his notice is: "What are we going to get out of it?" After all, this is but human nature, and the natural feeling of any living being, that if extra effort is made an extra reward should result. Therefore it is obvious to the dullest student of psychology that it would be useless to set standards and arrange routing to obtain a maximum output without providing the necessary encouragement in the shape of increased pay or bonus. There is one thing that must always be kept before one when fixing the amount and method of making the reward, and that is not to arouse the suspicion of the worker that he is being "done," by introducing a too complicated system of arithmetic.

There are many ways by which the superior and more industrious worker can be given the benefit of his extra ability and energy. Many employers still pin their faith to time payment, but this is usually very unfair to the good, honest worker unless carefully collated, authentic records are kept of all workers' ability and work, and rises given for individual efficiency. If this is done it is much more satisfactory and may spell for efficiency in output, but where we have the worker going his own pace, as it were, and trusting to the goodness or honesty of purpose of his employer to give him his just reward, his rises in pay therefore cannot be viewed as incentives to efficiency, because they are problematical, and if his master thinks he will go on at the same pace without a rise in pay, he will in all probability never receive any. They also come *after* the effort, and are paid for work which may not be nearly so well done as that which actually earned the rise. For this very reason many workers prefer a plain piece rate, and employers prefer it, too, as it is something very definite, and the wage calculations become a very simple matter indeed. Piece rates constitute a problem, to obtain the ideal, as the abilities of workers very often vary to such an extent that a rate upon which one worker can just earn a fair week's wage enables another to take away more money from the pay table than the shop foreman. To get over this difficulty. Emerson, the eminent American efficiency engineer, suggests that when the man has finished the task which gives him a fair wage, he should be allowed to leave his work, thus getting the benefit of his prowess in more leisure hours. This may be all right in a small works, and where most of the work is of an individual character, but when machinery is running and in large works, it introduces a difficulty concerning the waste of power on one hand, and the question of discipline on the other. The fixing of piece rates is a question for experts, and should only be done after due investigation, and not by guesswork. Haphazard methods of fixing piece rates have been the cause of more industrial unrest and strife than anything else. The most equitable method of applying incentive is undoubtedly by one of the several task bonus systems which provide a definite incentive to the worker to attain and exceed bonus standard. The various bonus systems all have minor points to recommend them individually, but collectively they are based upon the same principle; this is, that when the worker completes his standard task he earns a bonus and receives a piece rate for all work over the task. The introduction of such a system should be carefully explained to the workers, and a clear exposition posted up showing how their wages are calculated under it, when it will be found that an equitable wage system, carefully explained and thoroughly understood, by which the efficient operatives receive their just reward, undoubtedly encourages the co-operation of the workers in the efforts put forth to gain efficiency. Considered psychologically, the mere fact of providing a definite ideal which all workers are encouraged to make an effort to attain by the reward offered, is very sound, as it is human nature to require something to aim at, with a reward when one gets there. The task idea can be amplified and even introduced into clerical work where the diversity of work factor is not too great, so that throughout a works all are working to a schedule. It is usual to fix the bonus between 30 per cent. and 50 per cent. of the day rate. So it is possible for a man to earn that per cent. increase in his pay by his own efforts, assisted, of course, by the instruction cards, which are the outcome of the efforts of the efficiency engineer. It can truly be said of bonus systems that they include all the points in favour of time and piece rates, with none of the drawbacks of either. The bonus system also gives one a rough indication of the general value of the efficiency in the shop, and all cases of unattained or lost bonus should be carefully investigated. I have not yet said anything of profit sharing or proportional bonuses on the result of the firm's working. These are not always successful for several reasons. First, it is a bargain between two parties, employer and employé, one of which has every opportunity to cheat the other, and the other has no means of checking. Secondly, every worker benefits according to the amount of his present position and pay, and not *pro rata* to his industry and ability. Thirdly, from the employer's point it is anything but equitable, for out of 18 factors which affect efficiency, the worker only affects one, so therefore his share should be an eighteenth part. There are many instances where the profit-sharing system is in vogue, and working quite satisfactorily, but the majority of the workers appear to regard it as a lucky windfall, or gift from the gods rather than a portion of their just reward for their efforts on behalf of the firm.

There is no doubt that the task bonus system is the best method of providing an unmistakable incentive to the achievement of standard, and by turning the daily labours of the worker into a kind of competitive game with a definite reward for the winners, we go far towards solving the problem of industrial efficiency.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The Origin of Electricity Supply.

In your leader on electricity supply in your issue of May 30th, I notice you say that "If there had been no company undertakings to blaze a track through the forest of obstruction and disappointment in the early days, there certainly never would have been any municipal electrical undertakings or any I.M.E.A. to-day, and we cannot help feeling that the Association takes a narrow view of this subject, unworthy of its past."

Confirmation of your statement can be obtained by referring to the evidence given before a Select Committee of the House of Lords in 1886, when three amendment Bills were under consideration to extend the 21 years' purchase contained in the Act of 1882. On that occasion Mr. Edward Orford Smith, who gave evidence as town clerk of Birmingham, and also on behalf of the Association of Municipal Corporations of England, pleaded that electrical science was not then sufficiently advanced to ensure the practicability of an electric supply from a central station; but, in answer to further questions, he admitted that he had not read an account (published the day before) of the successful working of the plant at Paddington, and would not admit that the real obstacle had been the legislation of 1882.

He objected to a company coming to supply electric light, as it would demand power to break up the streets, and the Corporation of Birmingham had no intention of starting anything in the nature of electric lighting for itself, but he wished to extend its veto to Provisional Orders.

It is unnecessary to mention the indebtedness of the industry to the enterprise of public companies since that time, for all progress has been initiated and carried out by them, including the introduction of the steam turbine.

In 1893, when fighting numerous actions for vibration, I ordered the largest Parsons' steam turbines that could be made at that time, and although they were only 350 KW. each, all the troubles and defects which a turbine could possibly develop seemed to concentrate in these early efforts, and as a result Sir Charles commenced a triumphal progress, out of which municipal electrical undertakings have derived full benefit.

Frank Bailey, *Joint Managing Director*,
The City of London Electric Lighting Co., Ltd.

London, S.E., *June 3rd*, 1919.

The E.P.E.A. Award.

Your correspondent "Wessex," in last week's issue, asks: "How can the E.P.E.A. award apply to Mr. Harding or any of his colleagues who consider it *infra dig.* to join a trade union, and therefore, one naturally concludes, are not members of the E.P.E.A.?" Now, I will give your correspondent a few "crumbs" from other trade unions accepted by the E.P.E.A. at the London Electric Railways power station, Lots Road, Chelsea:—

National Union of Railwaymen's award of 48 hours per week; National Union of Railwaymen and Electrical Trades Unions' award of bonuses and 12½ per cent., totalling £2 6s. 4d. They also get a free holiday pass to almost anywhere in the United Kingdom, privilege tickets at half single fare return for self and wife, and quarter single fare return for children. On the top of all this they are trying to create "holy war" for 20 per cent. plus £90.

Now I ask: If the N.U.R. and E.T.U. awards extend to non-members why should not the E.P.E.A.'s award? Perhaps this ought to be brought to the notice of the Minister of Labour or the arbitrators when dealing with "hard cases." I see the E.P.E.A. are using the "strike" or "handing in notice" weapon they made such a song about a little while back.

Ulster McReavie.

June 9th, 1919.

"Shift Engineer's" statement that "A very considerable percentage of our members have received the full award" is, according to the latest E.P.E.A. report, incorrect. That report distinctly states that out of 636 undertakings, over 500 have not paid the claim or the award. However, I have now received the information I was seeking, and understand that about 80 per cent. of us are still in the cold. No doubt the knowledge that there are so many of us will console us; but alas, that knowledge satisfies no tradesman's bill, neither does it provide a summer holiday.

Still, one has other sources of consolation. "Shift Engineer's" curious use of metaphor for example, wherein he belauds moral suasion and speaks of steam hammers being used to crack nuts. The E.P.E.A. tells us most distinctly what moral suasion brings—patronising contempt—whilst even elementary commonsense demonstrates that moral suasion never yet charmed kernel out of nut shell. One has to use force. Consequently, as we wish for a particular kernel, so must we first crack the shell which surrounds that kernel; and the shell which surrounds our kernel is so hard, so thick, that we may have to use a steam hammer. So here we come to a full stop. Happily, we can once again smile, for does not our friend "Shift Engineer" inform us that in such a case the E.P.E.A. will not fail to "Draw the sword strongly"! ! ! This, indeed, is real Adelphi unadulterated; but then, what exactly is the effect of "drawing the sword strongly"? It may fly from one's hand with the vehemence of the "strong withdrawal," and go over to the enemy; whereat the insolent foe laughs, picks it up, and prods us with our own weapon. Or, perchance, the "strong withdrawal" may end in the unfortunate striking of one of our friends and comrades who stand around us. No doubt the fact that it *was* accidental, will console our comrade for the breaking of his jaw with the flat of our strongly drawn weapon; but, on the other hand, it may not—and one cannot deny that one has injured a friend and given the wicked cause for glee. It may perhaps fall out, that the "strong withdrawal," with a flourish, may affright the foe; on the other hand, he may be scornful and—use his weapon whilst "Shift Engineer" flourishes and "strongly withdraws."

No, my friend, no; we don't howl for blood, we don't howl for anything—it's abominably bad form. What we desire is peace; and if not peace, than to USE the sword skilfully. If in the using we are damaged, or go under, well—Kismet. At least, we have not been trodden under like worms, and that is something.

Now that our Association has officially informed us that about 80 per cent. of the total number of undertakings have not paid the claim or the award, one desires no longer to occupy valuable space in your columns. It, then, only remains to thank you and withdraw, not strongly, but graciously.

Connaught T. Smith.

June 9th, 1919.

Carbon Brushes.

In the paper on carbon brushes by Mr. P. Hunter-Brown, reference was made to the decreasing coefficient of friction with increased speeds.

I have been in the carbon-brush trade for ten years, and found this to be a rather general rule which, however, did not always hold true. I had attributed this characteristic to the probable fact that at high speeds the brush was not in such intimate contact with the commutator, or in other words, that more of an air cushion was present under the brush face.

Recent experiments, however, have indicated that there is a critical pressure for each grade of brush at which the coefficient of friction is constant at any speed. With lower pressure the coefficient of friction decreases with increased speed, whereas, with high pressure the coefficient increases with increased speed. This critical pressure is different for each grade, and is lower for low-friction brushes than it is for high-friction brushes.

National Carbon Co., Ltd. (Inc.),
E. H. MARTINDALE,
Sales Engineer.

Cleveland, O.,
May 21st, 1919.

German Accumulators in the War.—At the outbreak of war the German industry was faced with a tremendous call for batteries for submarines. The larger types required batteries of 220 cells of 4,500 amp. hrs. capacity, weighing 80 tons, and costing about Mk.¼ million. In 1917 86 submarines were placed in service, and in 1918 the monthly addition was from 10 to 14 submarines. In this connection the success of F. Bayer & Co. in producing synthetic rubber was of the greatest value for the manufacture of battery boxes. The output of synthetic rubber reached 150 tons per month in 1918 at a price of Mk.37 per kg. The army used large quantities of accumulators for lighting automobiles, signalling by arcs and wireless, lighting dugouts for gun crews and reserves, and lighting aircraft. The transport of cells for charging necessitated the substitution of celluloid for glass boxes to save weight. At first the celluloid was defective, particularly in its cementing, but the quality improved later. The prevention of spilling the acid was achieved by a number of devices, generally consisting of chambers connected with the interior of the boxes by small tubes in such a manner that the acid could not flow out of the ventilating openings. The need of small stationary batteries rose greatly owing to the ever-increasing dearth of petroleum and other illuminating substances, and produced a great scarcity of lead, which rose to Mk.90 per 100 kg. The prospects of the accumulator industry in Germany are very bad.—*E.T.Z.*

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The Callender-Frampton Service System.

Some years ago we briefly noticed this system, which is intended to facilitate the localisation of faults in cable networks by the simple method of looping-in the distributing cable into the consumer's premises. As the war conditions restricted extensions there has been little activity in laying new services; now that freedom is restored, it may be worth while to draw attention to this system, which has been improved in the interval.

Fig. 1 shows a three-wire distributor fed at both ends from the network boxes A and B, and having two-wire services taken alternately off either side of the system. One of the outers is cut at each service, and a loop is taken into the consumer's premises, this loop being completed through a removable copper link c in the house fuse set. It will be seen that by removing any one of these copper links the circuit may be broken at that point, and that by removing any two links on one conductor the intervening portion of that conductor may be disconnected for testing.

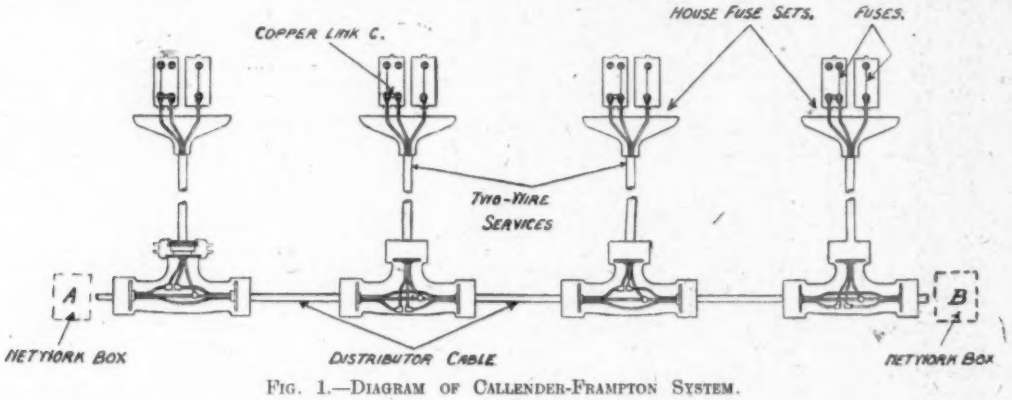


FIG. 1.—DIAGRAM OF CALLENDER-FRAMPTON SYSTEM.

By disconnecting only the shortest possible section of cable at one time (that is to say, the portion from one service to the next service from the same side of the system), the whole length of cable can be tested in successive sections without interrupting the supply to any installation supplied from that cable. Further, when a fault occurs, after it has been located by the method described below, the faulty portion of the cable may be isolated in the same way, and the supply reconnected to every service on the cable, leaving the fault to be repaired at leisure.

It will be seen that on the pole connected to the loop in the distributing cable the fuse contacts are in duplicate, but only one fuse is used, so that when a conductor of the distributing cable is broken by withdrawing the copper link the installation may be connected by the interchangeable fuse to whichever side of the loop remains connected to the supply. When a section of the cable is to be isolated, either for testing purposes or because a fault has been traced to that section, the first copper link at each end of the section of cable to be isolated is removed, and the fuse at each end is placed on that side of the break which remains alive.

When a fault has occurred to earth on one of the outers of a three-wire distributing cable, and the main fuse in the feeding network box has blown, the following method is adopted to locate the fault:—

Commencing from the end at which the cable is fed (if it is fed from both ends, the test may be commenced from either), the copper link is removed from the fuse box on the affected service nearest the network box, thus leaving connected to the network box only that portion of the cable on that side of the system between it and the first service, and disconnecting the remainder. A trial fuse is then inserted in the network box, and if the fault is in that section of cable this fuse will blow. If this does not happen, and if, when the house fuse is put in the side of the box nearest the network box, the lamps light up, then the fault is not in that section of cable.

The copper link at the next service on the same side of the system is then removed, and the one previously removed is replaced, thus connecting another section of the cable to the portion already alive; this process may be repeated, adding section by section and trying the lamps at each service, until the faulty section is reached, which will be indicated by the reconnected portion being found dead, owing to the trial fuse in the network box having blown.

Having now found the fault to be between two adjacent services, this section is isolated, and new main fuses are inserted in both network boxes, when every service on the cable may be furnished with a supply. In the case of a distributor fed at one end only, of course only those services between the network box and the fault can be given a supply while the fault remains.

Messrs. CALLENDER'S CABLE & CONSTRUCTION CO., LTD., of Hamilton House, Victoria Embankment, E.C., control the patent.

Tandem Resistance for Bioscope Arcs.

Our illustration (fig. 2) shows a tandem resistance, designed to obviate the possibility of overloading a bioscope generator, which is manufactured by MESSRS. AUSTIN WALTERS & SON, Gaythorn Electric Works, Little Peter Street, Manchester. When ordinary resistances are used the operator either switches off his first projector and then strikes the arc of the second, or, as is more often done, strikes the second arc before switching off the first, thereby seriously overloading the generator. By using a tandem resistance it is claimed to be impossible to overload the generator, and a three- or four-part film can be run through without any break whatever. When near the end of the first spool, the operator moves the resistance regulator on to the first contact of the second arc, which allows a small current to pass when the carbons are adjusted. The small arc created is not strong enough to project a light through the film or to interfere in any way with the first arc. The circuit having been made as described, the regulator is moved over the corresponding contacts as desired, which increases the current in No. 2 arc and decreases the current in No. 1 arc. It will therefore be appreciated that both projectors can be controlled without overloading the generator, as it is impossible to increase the current on either projector without decreasing it on the other. These resistances are not an experiment, and we are informed that numbers are in daily use, and giving entire satisfaction.

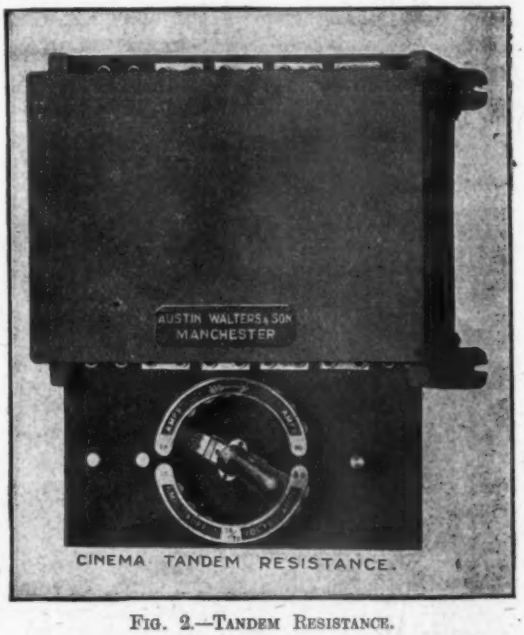


FIG. 2.—TANDEM RESISTANCE.

LEGAL.

MARCONI'S WIRELESS TELEGRAPH CO. *v.* THE CROWN.

(*Continued from p. 660.*)

MR. JUSTICE A. T. LAWRENCE sat again in the King's Bench Division on Wednesday, June 4th, to assess the damages due to the Marconi Wireless Telegraph Co. from the Crown for breach of contract in regard to the construction by the company of an Imperial chain of wireless stations round the Empire.

Sir EDWARD CARSON, K.C., M.P., continuing his opening address on behalf of the company, said there was no hostility on the part of the company towards the Government, and they would be prepared to do everything they could to meet the views of the Government with a view to future friendly relations. He put in a summary of the cable traffic showing the number of words transmitted from 1909 to 1916, with the percentage of increase worked out. With the exception of 1911 the increases were all over 10 per cent. (This figure being the basis of the company's claim, amounting roughly to £7,000,000.)

Evidence was then called. The first witness was Mr. GODFREY ISAACS, managing director of the Marconi Co. He said that when the company was founded in 1897 it had a capital of £100,000, and owned only one English and four foreign patents. In 1913 the capital had been increased to £1,500,000. The Marconi International Marine Communication Co., with a capital of £1,500,000, operated wireless installations on about 90 per cent. of the 2,587 ships equipped. In the earlier years of its existence the commercial development of the company was not so efficient or extended as the technical. That was mainly due to lack of energetic management, the company allowing anyone to use their patents. As a result the Germans usurped all the Marconi patents, and were using them in competition with the Marconi Co. The company had expended £450,000 on research work. They had an expert technical research staff of about 90, and were spending between £50,000 and £60,000 a year on research.

Mr. LESLIE SCOTT: What is the longest distance you have got messages through?

WITNESS: Between 12,000 and 13,000 miles—from Carnarvon to Sydney, N.S.W. The messages were received in Sydney by the managing director in Australia by means of an installation on the roof of his house. Commercial wireless communication direct with Australia would be possible if they constructed stations.

Mr. Isaacs spoke of the company's war work. They constructed stations abroad, beginning in 1915, for which they had to send every particle of the material, including bricks and mortar. These stations were constructed in a few months. They received, translated, and dispatched to the Government practically every word sent out by wireless from all over the world. Showing how wireless beat the cables, witness said when wireless was started between Vancouver and Honolulu in 1914 the cable traffic was approximately 250 dollars a day. Wireless began at the reduced rate of 25 cents a word, compared with the cable rate of 35 cents, and within two months the cable rate came down to 25 cents. In 1917 the cable traffic was still 250 dollars a day; the wireless traffic was 500 dollars a day. The wireless traffic increased more than threefold; the cable traffic remained stationary. The long-distance wireless installation between Clifden and Glace Bay, Nova Scotia, had, said witness, many disadvantages compared with what the projected Imperial wireless chain of stations would have provided. If erected to-day the masts would be 600 ft. high. Witness said that the figures of 80,000,000 words picked up and 8,000,000 words transmitted during the war were entirely Government work. In addition commercial work was done till nearly the end of 1917. Wireless had made great progress in recent years, and the traffic had grown beyond the company's capacity to handle. They had had to advise customers that they could not accept traffic, and had also had to cable thousands of words which could not be handled by wireless. He thought the traffic for many years, if the chain of stations had been established, would have shown a far greater increase than 10 per cent. per annum, which was the amount of royalty the company was to have under the contract. As for the probability of the company continuing to receive those royalties for either 18 or 28 years, as provided for in the contract, that was, he was confident, assured by the increasing experience and efficient working of the company and its officials, and the fact that the company and its associated companies adapted fresh inventions every year. Even were no fresh inventions forthcoming, in his opinion commercial wireless would be better carried out by a private company than by a Government department. The first reason for that was that a private company would reduce rates at a greater speed than a Government service, and reduced rates would lead to increased traffic. The whole policy of private enterprise was to reduce rates to the lowest possible figure and increase traffic to the highest possible maximum. In the second place, a private company like Marconi was able to open stations in foreign countries, and thus arrange through traffics, in that way increasing traffics.

Mr. SCOTT: Would the probability of new inventions by the Marconi and associated companies be of assistance?

WITNESS: They would be a necessity, for the traffic must necessarily grow with the development of trade, and apart from the normal growth and great growth which would have followed the substantial reduction of traffic which was contemplated, to be able to conduct the service efficiently would require to be introduced year by year every improvement that came along. It would have been essential to have the experience and inventions of the Marconi Co. if the British system was not to fall far behind foreign systems which were run by the Marconi service.

Cross-examined by Sir ERNEST POLLOCK (Solicitor-General) for the Crown, witness said the contract between the company and the Post Office was not a burdensome contract, but it involved risk and doing work which prevented them doing other work.

The SOLICITOR-GENERAL: Your claim is for £7,182,000. Was that the value you contemplated the contract would be worth to you?

WITNESS: I always regarded the contract as a very valuable one, but I have never put a figure to it, because I never went into that.

You never realised it was worth £7,000,000?

No. I did not realise it was for £7,000,000. I realised it was a very big scheme, but with complicated figures of this sort it is difficult to estimate what the amount is, unless you work it out as my auditors have done.

The hearing was adjourned.

On Thursday, Mr. GODFREY ISAACS was further cross-examined by the Solicitor-General. The witness was questioned in great detail about technical charges to Egypt and India, and expressed dissent from several suggestions put to him by the Solicitor-General. In further cross-examination, witness agreed with the Solicitor-General that though it was possible to wireless to Singapore, it was not possible to wireless on from Singapore to Australia. Had the Imperial chain of wireless stations been built when they were proposed to be built it would have been possible. If the station at Devizes had been completed it would have been possible to wireless to Australia, and an enormous amount of money would have been saved by the Post Office, who would thus have avoided sending through two or three stations.

The SOLICITOR-GENERAL remarked that the contract did not contemplate the erection of a station in Australia.

Sir EDWARD CARSON: The contract provides that the Singapore station should be able to communicate with Australia.

The SOLICITOR-GENERAL: I think Mr. Isaacs agrees with me that the erection of a station in Australia was a matter for the Australian Government.

Sir EDWARD CARSON: It was plainly contemplated that the Singapore station was to be one of the stations to communicate with Australia.

Mr. ISAACS: The Commonwealth Government were most anxious to put up their station.

Mr. Justice LAWRENCE: You would not put up the whole six stations simultaneously?

Mr. ISAACS: Certainly, we should, every one, just as we put up 13 stations simultaneously for the Admiralty in all parts of the world. We had undertaken in the contract to do so. They had all to be completed in 18 months.

The SOLICITOR-GENERAL put to witness figures relating to cable traffic in recent years with a view of showing how this traffic was affected by war.

Mr. ISAACS said: I think the trade of the world and the telegraphic traffic of the world will be phenomenal after this war, in consequence of the extraordinary conditions which have arisen, and in consequence of the entirely new competitive conditions which are going to obtain directly we have the restrictions on trade removed.

The SOLICITOR-GENERAL suggested that wireless was not so reliable as cable traffic.

Mr. ISAACS: I don't agree. The Germans found wireless more reliable than cables, because all their cables were cut.

The SOLICITOR-GENERAL inquired if there was a single instance of long-distance wireless traffic having shown a cumulative increase of 10 per cent. per annum over a series of years.

Mr. ISAACS replied in the affirmative, and instanced the San Francisco-Honolulu service.

The SOLICITOR-GENERAL: Is it true that the wireless traffic between Clifden and Glace Bay in 1913 was only 3 per cent. of the cable traffic and only 4 per cent. in 1917?

Mr. ISAACS: Probably, that may be so, but that service suffers from many disadvantages. Glace Bay is 600 miles from Montreal and 900 miles from New York, and depends upon the cable. At a subsequent stage, Mr. Isaacs said his contention all along had been that the wireless did not take away from the cable traffic, but created additional traffic by offering lower rates.

The hearing was adjourned to June 24th.

BRITISH THOMSON-HOUSTON CO., LTD. *v.* DURAM, LTD.

THE Court of Appeal, on June 5th, delivered judgment upon the appeal of the British Thomson-Houston Co., Ltd., from a judgment of Mr. Justice Sargant refusing their application for liberty to amend the specification of Letters Patent No. 21,513* of 1906 for an alleged invention relating to a process for the treatment of metallic tungsten, and for the manufacture of electric filament lamps therefrom.

Lord Justice WARRINGTON read a judgment in which he said the Master of the Rolls agreed. He said that at the

date of the application for liberty to amend there were proceedings pending for revocation of the patent. The section of the Act of 1907 under which the application to amend was made allowed a patentee to amend the specification by way of disclaimer on such terms as to costs and otherwise as the Court might think fit, but it provided that the amendment should not be allowed if it had the effect of enlarging the claim which was described at the date of the original application. Mr. Justice Sargant had refused to allow the proposed amendment as in his opinion the proposed amendment was substantially different from what was said at the date of the specification, and then he said that in his discretion he did not think fit to allow the proposed amendment. Having referred to the action which the appellant company brought against Duram, Ltd., the Lord Justice said that the section of the Act of 1907 under which the appellants applied for leave to amend never intended that anybody could change a bad specification into a good one. He thought that Mr. Justice Sargant was right in refusing to allow the amendment. It was impossible to say that Mr. Justice Sargant had not exercised his discretion on proper grounds.

Lord Justice Duke concurred, and the appeal was accordingly dismissed, with costs.

THE ATOM OF ELECTRICITY.

At the Manchester College of Technology on Tuesday, March 25th, before a crowded and very appreciative audience, a lecture was delivered by Sir Ernest Rutherford upon "The Atom of Electricity." Mr. A. P. M. Fleming, Chairman of the North-Western Centre of the Institution of Electrical Engineers, presided. In opening the proceedings, he explained that the lecture had been organised by the Institution to enable those who had little occasion or little opportunity to study the fundamental principles of science underlying electrical phenomena to remedy their deficiencies in that respect, and to enable those who had received a scientific training to renew their knowledge.

Sir Ernest Rutherford said the problem of the nature of electricity and its connection with matter had excited profound interest in the minds of scientific men since the experiments of Franklin in 1750. He was the first to formulate the theory, generally known as the "one fluid" theory, which supposed that electricity was an intangible, unweighable fluid permeating all bodies which were regarded as positively electrified when they contained an excess of it, and negatively electrified when they were deficient in it. Later, the "two fluid" theory was put forward, which supposed that there were two electrical fluids. While the controversy between the adherents of those two theories was proceeding, Faraday, in 1833, made his famous experiments in electrolysis, *i.e.*, in the effects produced by the passage of electricity through certain conducting or chemical solutions. The theory was that the solution in some way was broken up into a number of positively- or negatively-charged particles, and the passage of electricity through it really consisted in the movement of the positively-charged bodies in one direction and of the negatively-charged bodies in another direction. Faraday observed a remarkable relation between the amount of material deposited and the atomic weight of the element. Indeed, his experiments clearly showed that electricity was of an atomic nature, but it was not until many years later that this fact was tentatively recognised. Dr. Johnson Stoney, in 1874, was the first to point out clearly that the results of electrolysis were only explicable on the assumption of the atomic nature of electricity, and he made an approximate calculation of the actual quantity of electricity carried by the unit which he suggested should be called the electron.

The discovery of the X-rays in 1895 gave a great impetus to the study of the passage of electricity through gases. It was shown that a number of positively- or negatively-charged particles or ions were produced in the gas, and it was possible to study in much greater detail the way the charges moved, and to examine their effects. The neutral gas, or a certain number of molecules of it, was ionised by radiation. The question arose whether the charges carried by these ions in the gas were really of the same nature as the charges in electrolysis. One method adopted in the investigation involved magnifying ten thousand times the particles emitted by radium, which were rendered visible and counted at the rate of 5,000 a minute. The actual charge carried by the whole group of particles was determined, and, dividing one quantity by the other, they were able to arrive at the charge carried by each particle. There was another experiment made with cathode rays, in which the bright particles emitted by radium were observed shooting upwards at a velocity of the order of 50,000 to 100,000 miles per second. They looked like blue rays of light, but could be deflected to the right or the left by a magnet. These particles were negative electrons, consisting of negative charges of very minute mass. It was really the disembodied atom of electricity quite apart from any atoms of matter. The evidence was reasonably complete that the negative electron was the unit or atom of electricity, and that its mass was purely explainable by its electrical effect; in other words, there was no matter associated with it; it was just a flying atom of electricity. So far they had got the negative atom of electricity separated. Now came the question: What about the positive atom of electricity? Was there a counterpart of the negative electron? Many had searched for it during many years, but nobody had found a positive charge which was the counterpart of the negative. The lightest mass they could find of a positive charge was actually the hydrogen atom; in other words, an atom of matter. Why was this? Many people thought that they must get the positive electron of the same small mass as the negative electron. Personally, he believed they would never do so, that there was at this stage a real distinction between the positive and the negative atoms of electricity, and the positive would never be found of less mass than the hydrogen atom. His opinion was—and there was no evidence to contradict it at the moment—that the positive electron was the hydrogen atom positively charged.

A hundred million ordinary atoms put side by side would about cover the width of a finger, and the negative electron was about a hundred-thousandth the diameter of an ordinary atom of matter. This much could be said—with a certain hesitation, because it was not verified—that they seemed at this stage to have got the idea that there were two kinds of electricity which really differed from one another—probably not in charge, because the charge was the same, but in dimensions; and probably the properties of matter, the structure of the atoms of matter, were due to the fact that there was a real distinction between positive and negative electricity. So the "two fluid" people, though they did not know it, and deserved no credit for it, were really right.

The lecturer proceeded to show by experiments the effects produced by the negative electrons in motion, and also by the positive bodies, when passing through gas. Other experiments, he said, threw light on the structure of the atom. It could be shown that in a multitude of ways that the negative electron was a constituent of the atom of matter, a mobile constituent that could be easily removed. How was the atom built up? Assuming it to be an electrical structure containing electrons or negative charges, it must have a corresponding magnitude of positive charge to make it electrically neutral. Some interesting suggestions had been put forward, and one in which he and others believed was the nucleus theory. It was arrived at experimentally. If they watched some alpha particles passing through gold they would see that some were deflected and turned aside at right angles. This indicated that when the negative electron, flying along at 10,000 miles a second, got inside an atom it came into collision with something which gave it a violent deflection. Experimental investigation led to this conclusion. The atom was built up in a rather surprising way. At the centre was a very minute nucleus which carried a positive charge; surrounding it on the outside were a number of electrons arranged at distances which, proportionately to the actual dimensions, might be called vast. If they imagined the nucleus in the centre to be about the size of a football in the middle of that room, the nearest electron would be out in the street and the furthest electron 400 yd. away. The electrons occupied the space, but did not fill it, and in the centre was this nucleus. Obviously the arrangement of the electrons was defined, and the properties of the atom were defined, by the magnitude of that charge in the centre which contained practically the whole mass of the atom. No doubt it was complex in itself, although of such minute dimensions.

Now by measuring the scattered particles one could form an idea of what was the actual charge on the nucleus. In an atom of gold one might say it had about 80 of the atoms of electricity. It could not be done very accurately by that method, but it was possible to get an estimate, and the general result seemed to show that the actual nucleus charge in the centre of the atom was about one-half of its atomic weight. Obviously, if the atomic theory of matter held they could not have one atom 20 and the next one 20½; they could only have 20, 21, 22, and so on. Probably, therefore, the nucleus charge would vary by definite units or atoms of electricity. That view received a very remarkable verification by the work of Moseley in studying the wave length or frequency of the X-rays produced by the cathode rays. Moseley, who lost his life in the Dardanelles, was one of the ablest of the University's younger physicists. He took a whole system of elements, put them in a tube, and fired the cathode rays upon them. That gave rise to the X-rays which were characteristic of those elements, and by observation of the vibration of the lines in the spectrum he was able to show that the frequencies were proportionate to the square of certain numbers which were now called the atomic numbers. Starting with hydrogen as 1, helium was 2, lithium 3, and so on. The general evidence showed that the charge on the nucleus of the atom was 1 for hydrogen, 2 for helium, and so on. Moseley was not able to verify the whole series of elements, but since his death the investigation had been carried as far as the highest element, uranium, which had an atomic weight of 92. With four exceptions, the atomic number of every element from 1 up to 92 had been verified.

He had said the nucleus was a very small thing. What must its composition be? There was reason to believe that the nucleus was built up of simpler units. It was a complicated thing consisting of positive atoms of hydrogen and helium with negative electrons mixed with them, but on the whole the positive charges were greater than the negative.

Although so minute, it was composed of a large number of bodies, and presumably was a system in itself, a system, so to speak, guarded on all sides by the electrons round it.

It might be asked, how were they to penetrate into the nucleus to find out what it was made of? There was some evidence which threw light upon that point. The general evidence was that the mass of the nucleus must be of the same order as the electron itself. If they could get particles swift enough to penetrate into the interior of the nucleus of any atom a large amount of information could be got by studying the deviation of swift particles that were flying through matter, the reason being that they penetrated right into the inner centre of the atom, and the forces involved in those collisions that he had spoken about were exactly the same as the forces involved when two atoms, say of helium and hydrogen, were in collision. Although these bodies were infinitesimal the forces at work were measured in pounds. The great problem was whether they would break down under the impact of these enormously swift particles. That was the problem of the future.

They had now arrived at this stage, that the atom of matter was nothing more than electricity. In fact, the whole of matter was really a manifestation of electricity, and they sought to explain the properties of matter by the combination of negative and positive charges. His audience would understand that although a great advance had been made in the knowledge of these things, when they reached the point of being able to discuss the possibilities of the structure of the atom they had still a long way to go. The great problem of the relation between electricity and matter was of fascinating interest to scientists, and he thought it would be the great problem lying at the base of science for years to come.

A vote of thanks to the lecturer was carried unanimously.

BUSINESS NOTES.

Another German Retreat.—The *Frankfurter Zeitung*, refers with regret and anxiety to the increasing number of retirements of leaders in banking, industry, and commerce, as it regards it as essential that they should remain at the service of German economic life, their work being more indispensable in the future even than in the past. The tendency among leaders to forsake their posts has also been present in Hungary under the new régime, and it led in April to the issue of a decree by the Hungarian Revolutionary Council providing (says the *Neue Freie Presse*) that the present directors, managers, and officials of the industries to be socialised are bound to remain in their positions and to continue to carry on their undertakings to the best of their ability, so far as they were at their posts at March 22nd of the current year, or were prevented from carrying out their duties by no fault of their own. Their salaries must not be more than before, but in no case are they to exceed Kr.3,000 monthly. Anyone contravening these regulations is to be brought before the revolutionary tribunal.

Electrical Appliances for China.—We have received a copy of the February issue of the *Far Eastern Review*, published in Shanghai, and having London offices at 97, Gresham Street, E.C.2. It is a special and very bulky number (10s. 6d., post free), devoted specially to the subject "Ports of the Orient." It contains a large volume of information which should be of service to firms and others interested in trading operations with the Far East. Attention is specially devoted to China. In the course of an article on "The Chinese Market for Machinery," it is stated that the use of electrical appliances is naturally limited to those cities and districts where electric power is obtainable, and the constant growth of this trade under these circumstances is promising. "A great many electric power plants have been unable to get machinery during the past year to take care of natural increase in consumption, and new contracts for current have been subsequently refused. With an increased import of appliances under such circumstances we can only infer to what size the business would have grown under normal conditions."

Industrial Relations.—In the course of his speech at the annual meeting of Richardsons, Westgarth & Co., Ltd., at Hartlepool, to which reference is made in our "City Notes" to-day, Mr. D. B. Morison, the chairman, said:—"With regard to the industrial outlook, provided that labour, in striving for the immediate realisation of high ideals, is not forgetful of the frightful financial obligations that this country has to face, and provided also that we—and I refer to both capital and labour—work together with a determination to win out in the coming industrial world struggle, then we can say, 'All's well.' If, on the other hand, we refuse freely to recognise that the highest productivity possible, in association with correspondingly high pay, is a governing factor in the attainment of success, then the realisation of this economic fact will be forced upon us by the dire experiences of an industrial cataclysm of the first magnitude. As between these two alternatives and their inevitable consequences a decision must be made by capital and labour; together, and together only, capital and labour will stand or fall, and on the choice of these alternatives depends the future of manufacture in this country."

The Industrial League.—On June 3rd the Executive of the Industrial League explained the aims and policy of the League to the technical Press. In an introductory speech, the chairman, Mr. G. H. Roberts, M.P., President, said that it was established by a few people of imagination, to do something for their country in the trying times that would follow the war, and that the country was emerging from that ordeal more successfully than might have been hoped was in some measure due to the influence of the League. In the war all classes had learnt their value to the nation; every worker should have good wages, security, a decent home, and the amenities that made life worth living, but the League did not take a one-sided view of the question—there must also be increased production. Men could not be guided by things that they did not understand; the great mass of the people was ignorant of the principles of production, and the League was out to educate both employers and employed. The nation had to choose between harmony and conflict; the latter meant irreparable disaster to all parties, while harmony guaranteed efficiency and success. Unless harmony were very soon established, our country would be handicapped for ever in the markets of the world; unless our home and foreign trade constantly expanded, the nation must suffer. The Industrial League supported the demand of the workers for a fuller and richer life, but taught them that they must exert themselves to gain it.

Mr. H. E. Blain, vice-president, said that suspicion and distrust between man and man, and between class and class, were infinitely mischievous; the welfare of all depended upon the strength and rapidity with which those feelings could be stamped out. Few had thought that the first six months after the war would pass so peacefully as they had passed; firmness on the part of the Government, fairness on the part of the employer, and understanding on the part of the employé, were indispensable to industrial peace, and the whole future of the race depended on the success with which the tenets of the League were carried into practice. Co-operation between capital and labour was absolutely essential. They were organising branches of the League, embracing men of all parties, religions, grades, and classes; they believed in their fellowmen, and desired to benefit their race and to develop the spirit of co-operation. In August a three-day conference would be held, at which the subject would be discussed, and he asked for the hearty support of the Press.

Mr. E. J. P. Benn drew attention to the practice of the daily Press of distorting the facts in reporting speeches, and pointed out that Mr. Roberts had not spoken of the Whitley Report.

Mr. Roberts agreed that the trade and technical Press had maintained a free and independent attitude, and said that the discussion of the facts regarding British and foreign trade was of great influence in counteracting the anarchistic tendencies of the day; they must plan very carefully lest they should upset that very complex machine. The prosperity of the working classes was only possible when trade and industry were established on a safe and stable foundation. The Whitley Report contained a great idea, and would be the salvation of our country. They should bring the workers down from the clouds and confront them with actualities, in their own interest. Workers were entitled to a brighter life, but must work to win it; to teach them was the work of the Industrial League.

The German Bosch Business.—The Robert Bosch Co., Stuttgart, reports for the year ending September 30th, 1918, a net profit of Mk.3,799,252, against Mk.4,290,423 in the previous year. In 1916-17 a dividend of 10 per cent. on the Mk.12 mill. capital was paid, but this time it is proposed to make no distribution, but to place Mk.2,632,000 to reserve against war taxes, Mk.100,000 to the legal reserve, and Mk.200,000 to special reserve, carrying forward Mk.867,252. The book value of the works has risen from Mk.5.97 to Mk.7.36 mill. raw materials, part finished and completed products Mk.21.99 mill., securities Mk.12.35 mill., and debtors Mk.14.96 mill. On the other side the loan debts were Mk.15.24 mill., bank debts Mk.1.95 mill., and current debts Mk.20.77 mill. The special reserve fund for conversion to peace production is Mk.1 mill. The directors regard the greatly increased stocks as a source of danger of loss, as they are chiefly products which are either useless after the war, or would require conversion for peace purposes. A further important danger is the large amounts outstanding in Austro-Hungary. The bank balances, which amounted to over Mk.10 mill. in the previous year, are completely exhausted, and future prospects are poor. The company is taking up the sale of its former peace production, but it is doubtful how far it will be able to regain its former foreign customers for same.—*Frankfurter Zeitung.*

It is indeed "doubtful."

Opening Credits on Behalf of Enemies.—The Board of Trade have issued a General Licence under the Trading with the Enemy Proclamations authorising persons in the United Kingdom to open credits on behalf of persons or bodies of persons in enemy countries for the purpose of financing transactions that have been authorised under Trading with the Enemy legislation in the United Kingdom or any other part of his Majesty's Dominions, and transactions between persons residing or carrying on business outside his Majesty's Dominions which have been authorised by the Allied and Associated Governments, or any of them.

Catalogues Wanted Abroad.—British trade catalogues of industrial machinery, electrical machinery, appliances and equipment, electric railway equipment, and scientific instruments, may be sent to Mr. Field, H.M. Trade Commissioner at Toronto, 257-260, Confederation Life Buildings, Toronto, by August 15th for display for inspection by Canadian buyers at the Bureau of Information which will be open at the Canadian National Exhibition during the last week in August and the first week in September.

Catalogues of British firms desiring to do export trade with Czecho-Slovakia, should be sent to H.M. Chargé d'Affaires, British Legation, Prague.

British catalogues intended for the interior towns of Turkey should be sent to Mr. A. Waugh, British High Commissioner, Constantinople.

German Wage Demands Retard Business. — The Herrman Löhnert Co., in Bromberg, has numerous pressing inquiries for special articles, but buyers are generally postponing their orders, as they cannot make up their minds to pay the high prices asked in consequence of the wage demands of the workmen.—*Koln. Ztg.*

According to the *Weltwirtschaftszeitung* of May 2nd, the Leipzig Fair at the end of April was a record as regards the number of exhibitors and the number of would-be purchasers. Of buyers from foreign countries, about 700 were from German-Austria; between 600 and 700, Czecho-Slovakia; about 200, Moravia and Austrian Silesia; between 250 and 300, Sweden; about 600, Holland; about 350, Switzerland; about 250, Denmark; between 30 and 40, Norway. There were also a few visitors from enemy countries and about 300 exhibitors from foreign countries. The large share taken in the Fair by German industries might be claimed as a proof that Germany had already surmounted to a very considerable extent the economic difficulties resulting from the Revolution; but that is not the fact, for the very high prices of the exhibits caused by the high wages prevalent throughout the country considerably affected the business done. But, says the paper mentioned, the first Peace Fair certainly did show that German manufacturers are turning their backs on "substitutes."

The well-known contractors, the Philipp Holzmann Co., in Frankfurt a.-M., who formerly had developed an active business in constructional work in foreign and overseas countries, state in their report for 1918 that since the outbreak of the Revolution there has been a serious reduction in the output of workmen and a lack of desire to work, while at the same time there have been continual unreasonable wage and salary troubles and exaggerated demands for reduction in hours of work. The direct effects were disproportionately high working expenses, wasteful use of expensive machinery and tools, and a far longer time employed in construction. Indirectly these conditions, along with the lack of raw material and the growing traffic difficulties, must hinder the expected revival of building activity and not only reduce profits, but also affect most seriously the general national economy.

The *D.A.Z* (April 5th) says that complaints such as the above are not new, but are common to-day to every industry employing heavy labour, and, well known as are the causes, equally difficult is the remedy. But they must be brought to notice, in order to draw attention to the aims towards which the efforts for reconstruction of the national economy must be directed.

Space Still Available at the Athens Exhibition.—As we have already informed our readers, the Federation of British Industries is organising a British Manufacturers' Exhibition in Athens. It will be held in October and November next. At the present moment there is a great demand in Greece for practically every description of manufactured article produced in this country. We need hardly point out, therefore, that the Exhibition affords our firms an excellent opportunity of introducing their goods to Greek buyers. There is still some space available in the Exhibition, but manufacturers should not delay sending in their applications. Among the articles mentioned by the B.F.I. Special Commissioner in Athens as being greatly in demand, are the following :—

Machinery of every description, particularly agricultural machinery.
Railway rolling stock, &c.
Electric dynamos, &c.
Automatic telephones.
Fertilisers and chemicals generally.

Italian Electrical Companies.—There has been formed at Milan a company styled Fabbrica Italiana Lampadine Elettriche, S.A., with a capital of 2,500,000 lire, for the manufacture of electric lamps.

A company has been formed at Mondovi Carassone with the title of Industria Ceramiche Elettro-refra Harie La Vittoria, to take over the business of the firm Ceramiche Georgis ed Industrie Ceramiche Nicolone Sard e Ca.

The following companies have increased their capital :—Società Idroelettrica Piemonte, Turin, 15,000,000 to 40,000,000 lire; Società Elettrica di Benevento, Milan, 375,000 to 1,500,000 lire, increasing eventually to 3,000,000 lire; Società Elettrica Milanese, Milan, 3,000,000 to 5,000,000 lire; Società Elettrica Sarda, 1,200,000 to 10,000,000 lire; Forze Idrauliche dele Appennino Centrale, Florence, 2,000,000 to 4,000,000 lire; Società Elettrica Bergamasca, Bergamo, 6,360,000 to 10,000,000 lire; and Elettrica Commense A. Volta, Como, 6,000,000 to 8,000,000 lire.

The Società Italiana di Utilizzazione Forze Idrauliche, Milan, capital 80,000 lire; and the Società Anonima Gaz ed Elettricità Palermo, have gone into liquidation.

Import Restrictions.—The President of the Board of Trade, after duly considering the recommendations of the Consultative Council on Imports, has given the following further directions in regard to the Prohibition of Import :—

The restrictions on the importation of the following articles are to be removed, and general licences have been issued :—

297. Celluloid in sheets, rolls and rods.
307. Aluminium sheets, foil, circles, rods, bars, ingots, angles, wire, tubes and strip.

The importation of the following articles is to be licensed only exceptionally as and when required :—

334. Manufactures of celluloid except sheets, rolls and rods.
335. Manufactures of aluminium except sheets, foil circles, rods, bars, ingots, angles, wire, tubes and strip, also powder and hollow ware.
339. Door bells other than electric bells.
343. Electrical toys.

The importation of the following articles is to be restricted as shown :—

350. Manufactures of bone, horn, and ivory, are to be admitted at the rate of 100 per cent. of 1913 imports.
352. Gas mantles are to be admitted at the rate of 100 per cent. of 1916 imports in quarterly amounts.
355. Insulating cloths and tapes (including varnished cambrics and oiled silks) are to be admitted at the rate of 25 per cent. of 1913 imports.
356. Carbons for arc lamps, cinemas and searchlights, are to be admitted at the rate of 20 per cent. of 1916 imports.

Applications for special licences should be made as usual to the Department of Import Restrictions, 22, Carlisle Place, S.W. 1.

Import Relaxations and Restrictions.—The concluding meeting of the Consultative Council on Imports was held at the Board of Trade on June 2nd. In view of the completion of the Council's work, the *Board of Trade Journal* of June 5th contained a consolidated up-to-date list of the import relaxations and existing restrictions. The list is divided into two parts :—(1) The articles which may, and (2) those which may not, be imported without licence from the Department of Import Restrictions.

New Swedish Company.—A new electrical engineering concern has lately been organised at Trelleborg under the title of the Svenska Elektriska Verkstad Aktiebolag.

Royal Visit to Braby's. — Prince Albert visited the Ida and Victoria works of Messrs. Braby & Co., Ltd., at Deptford, last Friday, in connection with the Industrial Welfare Society.

Chemical Works Fire Loss in Germany.—The Electro-Saltpetre Works Co. in Berlin, formed in 1915 by the A.E.G. and the Grieshiem Electron Chemical Factory with Mk. 3 mill. capital, suffered severe loss in 1917 by a great fire and explosion, and closed the year 1918 by carrying forward the loss, increased from Mk. 1,211,958 to Mk. 1,417,209.

Co-partnership in German Steel Trade.—The North-West Group of the German Iron and Steel Manufacturers' Association has joined with the Workmen's Organisation in a working partnership. A Chief (District) Committee of the Association of Free Employers' Unions is to look after affairs for the Unions combined in this working partnership for the Rhenish-Westphalia District. The business is to be conducted by the German Overseers' Union.—*Köln. Ztg.*, April 27th.

Trade Announcements.—MESSRS. T. J. GRAINGER & CO. have changed their address to Street's Building, 87, Westgate Road, Newcastle-on-Tyne (Telephone, Central 2998). The stores department is at 17, Dean Street, Newcastle-on-Tyne (Telephone, Central 3474).

THE BRITISH THOMSON-HOUSTON CO., LTD., of Rugby, in order to deal with increasing business in the Liverpool district, have opened an office and stores at 33, James Street, Liverpool (Telephone number, 358 Central; Telegrams, "Asteroidal," Liverpool). The new stores will carry a stock of wiring supplies, electric light fittings, and "Mazda" lamps for ship lighting and general purposes, and will deal with inquiries for all classes of B.T.H. electrical apparatus, such as turbines, generators, motors, switchgear, control gear, &c.

MR. G. C. GOWAN, who has been demobilised, has recommenced business as an electrical engineer and contractor, at 58, High Street, Aylesbury.

MR. J. HALEY, discharged from the Army as unfit for further service, has commenced business as an electrical engineer and contractor, at 5, Hanover Street, Halifax.

MESSRS. POOLEY & AUSTIN are moving on June 16th to temporary offices at 69, Victoria Street, London, S.W. 1.

Mr. Andrew Chalmers has resigned his position of assistant manager, electrical department, William McGeoch & Co., Ltd., 28, West Campbell Street, Glasgow, and has started business under the firm name of ANDREW CHALMERS & MITCHELL, electrical and mechanical engineers, brassfounders, and general merchants, at 49-51, William Street, Anderston, Glasgow.

Electric Lamp Manufacturers' Association of Great Britain.—The new telegraphic address of this Association is: "Britelma, Cannon, London."

Auction Sale.—By direction of the U.S. Government Engineering Department, Mr. R. H. Ruddock, instructed by Messrs. J. G. White & Co., will sell by auction on June 17th, at the American Government Engineering Department, Didcot, a quantity of new engineering equipment and stores, comprising Parsons oil engines, dynamos motors, &c. See our advertisement pages to-day.

Assets Auction Co., Ltd., will sell by auction on June 18th, at 119-121, Newington Causeway, London, S.E., the stock of an electrical goods factor. Full particulars, &c., appear in our advertisement pages to-day.

For Sale.—Maidstone Corporation invites offers for one balancer (2 × 230 v.); the Disposal Board, Ministry of Munitions, has for sale one new 500 H.P. Mirrlees, Bickerton & Day Diesel engine, with spare parts, &c. Full particulars are given in our advertisement pages to-day.

Battery Manufacture in Australia.—In the *Industrial Australian and Mining Standard* for April 24th, just to hand, there appears an article announcing the building of a factory situated at Blackwattle Bay, Glebe Point, Sydney, for the manufacture of storage batteries. There is works accommodation for 200 or more hands, but at present only 15 are employed. The company—Accumulators, Ltd.—only began operations at the works at the beginning of the present year. The present capacity is for turning out £50,000 worth of batteries per annum, but it is stated that this output could be increased five-fold with adequate protection. Batteries for train-lighting sets have already been provided to the Commonwealth and State Railways, and others have been supplied for house lighting. Beginning with a capital of £5,000, authority has since been received from the Government to increase this to £15,000. Among other things stated in the article are the following:—Storage batteries are quite 95 per cent. lead. This the company purchases from the Broken Hill Pty. Co. The wood lead-lined boxes are made of Australian pine, and later on it is intended to manufacture, or have manufactured, in Australia the glass jars which are often preferred to the wood lead-lined boxes. With the exception of these glass jars, not one part of the storage battery is imported from abroad. At present British storage batteries are allowed into the Commonwealth free of duty, and there is only an *ad valorem* duty of 10 per cent. on foreign batteries. This the company considers is entirely inadequate. It asks for an *ad valorem* duty of at least 25 per cent. upon batteries of British manufacture and 35 per cent. on batteries of foreign manufacture.

Book Notices.—*The Decimal Educator.* Vol. I, No. 4. June, 1919. London: The Association. Price 6d.—In the present issue of this publication we note several articles and notes on lecturing, which will be found useful by those organising public lectures for the dissemination of the principles of decimal counting. Other matters of interest that are dealt with are the annual report of the Decimal Association and the progress of the Royal Commission on Decimal Coinage, whilst the metric system in the gas industry and the London County Council's views are dealt with in instructive articles.

"Income-Tax up to Date, including an Explanation of the Excess Profits Duty as Revised." By H. J. Gully, F.C.A. Revised Edition. London: *Financial News.* 9d.; post free 10d.

The June issue of *Mayfair* (2s.) is a special aircraft number. It is charmingly produced, and contains numerous excellent half-tones of men who are prominent to-day in the aircraft world, also of aircraft factories and machines. A full-page cartoon in beautiful colouring is included of the Hon. Mr. Justice Sankey, chairman of the Coal Commission; another, equally effective, shows Major-General Sir W. Sefton Brancker, K.C.B., who did fine work under the Air Ministry.

Dissolutions and Liquidations.—FALK, STADELMANN AND CO., LTD. (AUSTRALIA).—It is announced in the Australian papers just to hand that the Minister for Trade and Customs has appointed Mr. R. H. Shackell, of 59, William Street, Melbourne, controller of the business in Australia of the above company.

WELSBACH LIGHT CO. OF AUSTRALASIA, LTD.—A similar announcement appears regarding the appointment of Mr. Thomas Brentnall, of 360, Collins Street, Melbourne, as controller in the case of this company. Particulars of debts, &c., had to be sent to these gentlemen by April 14th in the case of the former, and by May 2nd in the case of the latter, company.

GILL & COOK, consulting electrical and telephone engineers, Winchester House, London, E.C.—Messrs. F. Gill & W. W. Cook have dissolved partnership. Debts will be attended to by Mr. W. W. Cook.

BROWN BAYLEY'S STEEL WORKS.—Meeting, July 8th, at 5, Gray's Inn Square, W.C., to hear an account of the winding up from the liquidator, Mr. H. Ashford.

VULCANIZED FIBRE, LTD.—Particulars of claims, &c., to be sent by June 30th to the liquidator, Mr. C. Cooper, 60 and 62, Spring Gardens, Manchester.

CONSOLIDATED DIESEL ENGINE MANUFACTURERS, LTD.—Sir W. B. Peat, the liquidator, stated at a meeting of shareholders, held on June 3rd, that when the order for liquidation was made the assets showed a total of £283,714. During the war the works of Carel Fréres were taken possession of by the Germans, and they were in the possession of the Germans when he was appointed liquidator in November, 1914. As soon as it was possible after the Armistice the chairman of the committee, together with other members, went over to Belgium and interviewed the people there with regard to the position of the works as the Germans had left them. Colonel Bridges, a member of the committee, made a valuation of the works as they stood at that date. They met Messrs. Carels and another gentleman, who was an intending purchaser, and they thoroughly examined the position of affairs and the prospect of selling the company's 10,001 shares in that company. They were faced with the position that the company had no funds, and that they were urgently in need of funds, and they were discussing a reconstruction of the concern. They received for these 10,001 shares over £150,000 in cash. Messrs. Carels had had a claim against the Consolidated Diesel Co., and the company also had a claim against Messrs. Carels, but a compromise had been arrived at. Their total realisations had been £280,636. So far one distribution had been made to the shareholders—namely, 10d. in the £—and the committee now recommended the declaration of another 5s. in the £. The proposed dividend was approved by the meeting.

Catalogues and Lists.—MESSRS. ADAM KNOX & SONS, LTD., 47, Crownpoint Road, Glasgow.—Leaflet describing the "Reliable" visual indicator for winding-engine signals, non-cumulative and mechanically operated.

MESSRS. H. DUNOD & E. PINAT, quai des Grands-Augustins, 47 and 49, Paris, VIe.—Catalogue of publications on science and industry.

Bankruptcy Proceedings.—FREDERICK JAMES EARLE, 3, St. Nicholas Street, Truro, Cornwall, late Lemon Quay, Truro, electrician.—The adjourned public examination of the above debtor took place at the Town Hall, Truro, on May 13th. Defendant was apprenticed to a chemist, but in 1906 joined the Army. In 1916 he was invalided out of the service with a pension. In 1918 he became a cinema operator at 35s. a week. While at the cinema he started business as an electrician. He secured some goods on credit. He went to London to obtain some money (£50), became ill, and was sent to hospital. During his absence his goods were sold by order of the Sheriff. He attributed his present position to the sale of his stock for the low sum of £90; he considered it worth £300. His deficiency was £411. He hoped all along to be able to pay his creditors in full, although he did not remember making profit on any contracts. The examination was closed.

Tanks for Sale.—Thirty fighting tanks are included in the immense variety of goods which are being sold by direction of the Disposal Board of the Ministry of Munitions. It is thought that some public bodies or Associations may favour the idea of using these attractive objects for raising funds for local charities, &c. The tanks are at present lying at the Training Centre, Wool, Dorset, and will be disposed of by tender.

LIGHTING AND POWER NOTES.

Accrington.—At the Council meeting, last week, reference was made to a resolution that the existing water turbine at the sewerage works be so arranged, and necessary plant installed, as to transmit to the Corporation mains electricity not required by the Sewerage Board. This arrangement would pay 20 per cent. upon the outlay. The decision to increase existing charges for energy by a further 10, per cent. applied to all customers. A L.G.B. inquiry would be held on the application to borrow £85,000 for extensions to the electricity works.

Barrow.—CONFERENCE ON ELECTRICITY SUPPLY.—With a view to bringing together all the local Council representatives and power users in the Furness and South Cumberland area, to consider the electrical supply for the whole district, the Mayor of Barrow has, with the approval of the B. of T., convened a meeting, to be held at Barrow Town Hall on July 1st, the object being to prepare a scheme which can be handed over to the District Board, so soon as it is constituted, and be submitted by the latter to the Electricity Commissioners. The Ulverston U.D.C. has appointed representatives to attend the conference.

Battle.—The U.D.C. has decided to support the Hastings T.C. scheme to supply electricity to the district.

Bedford.—NEW SERVICES.—The L.G.B. having withdrawn restrictions on the borrowing of money for making house connections, all such connections applied for are to be made subject to the consumer paying the cost of all cable laid on private property. Meter rents of all newly-installed meters are to be increased to 12s. per meter, per annum; charges in respect of existing meters to remain as at present. Particulars in support of a loan of £1,000 for these works are to be prepared, and a power supply is to be given to the Bedford Ice Factory subject to the necessary guarantees being given.

EXTENSIONS.—It was reported that there was not sufficient plant in hand to put existing plant out of commission long enough for thorough overhauling, and that even when the 1,000-KW. turbine was replaced there would still be risk. It was agreed that the scheme authorised on March 26th last be now proceeded with, and that tenders be invited for plant and buildings. As originally intended, it was proposed to install one 1,500-KW. set, the same size as the existing one, but generating at 6,600 volts, instead of 2,100 volts. The existing transformers would be used as occasion required for stepping down for general supply instead of up as at present. It was proposed to install two boiler-plant units, each with a capacity of 30,000 lb. of steam per hour. The induced draught plant would be converted from steam to electrical drive; the four coal bunkers would be duplicates of the existing ones, and it would be necessary to provide for the mechanical handling of ashes and clinker.

Blackburn.—L.G.B. INQUIRY.—On June 3rd, Col. T. C. Ekin, of the L.G.B., held an inquiry respecting an application for sanction to borrow £250,000 for the erection of a new electricity generating station at Whitebirk. The site comprised 64 acres, at a rent of £480 per annum, with a 10 years' option to purchase. There was an excellent supply of water from the canal, and transport facilities would be provided by the canal and railway. The new station was designed so as to form part of a complete scheme for the district. That clause was framed after conference with the B. of T.

Birkenhead.—MAINS EXTENSIONS.—The L.G.B. has informed the T.C. that it can now borrow £1,925 for mains and cable extensions under an old sanction.

Bradford.—MAINS EXTENSIONS.—The engineer has been instructed to proceed with the extension of E.H.T. feeders at High Street, Great Horton, and the provision of transformer-chamber equipment, at an estimated cost of £1,600.

Bray (Co. Wicklow).—LOAN SANCTION.—The Irish L.G.B. has sanctioned the Council's application for a loan of £5,000 for extension of the electricity works, repayments to spread over 15 years.

Bury.—YEAR'S WORKING.—There was a loss on the year's working of the electricity undertaking of £1,983, to be taken from the reserve fund. Coal cost £20,200 during 1918-19, against £14,600 in 1915-16, and wages have gone up from £5,132 to £10,706 during the same period.

Ceylon.—WATER POWER.—According to *Indian Engineering*, compared with India and some other countries, the possibilities of hydro-electric power production in Ceylon at moderate cost are far superior. The Ceylon Industries Commission urges on the Government the desirability, without loss of time, of completing a thorough investigation of the possibility of using the power available. The Public Works Department has investigations in hand on several streams. Only one scheme, that in connection with a supply for Colombo, is being gone into in detail.

Clayton (Yorks.).—PROV. ORDER.—The Bradford electricity department states that it has been in communication with the B. of T. respecting the proposal to apply for a prov. order to supply and distribute electricity to Clayton, and the Corporation gave formal notice of its intention to apply for the order. The Clayton Council approved the action.

Continental.—SWITZERLAND.—A movement tending to concentrate the generation and distribution of electricity into one large undertaking is making itself apparent in Switzerland. In 1916 the company styled Forces Motrices du Canton de Berne Soc. Anon. bought up the Forces Motrices du Wangen S.A. for 10,000,000 fr., formerly the business of the German firm of Lahmeyer & Co., of Frankfort. At the end of last year the first-named company also bought out the whole of the shares of the Forces Motrices de Laufenthal Soc. Anon., at Laufon, and undertook the working of the installations of the last-named company with the two stations at Dittengen and Zroingen. The Berne company has now absorbed all the smaller or secondary companies in the Canton, solely from the impossibility of the smaller concerns to cope with the increasing demands which the growth of the electrical industry is making upon companies. A like movement of concentration is apparent in French Switzerland. At Lausenne, a company has been formed styled Ouest Electrique Soc. Anon., with the object of uniting all the electrical concerns of French Switzerland. The capital is 5,000,000 fr., and the Government of Geneva has taken shares to the value of 600,000 fr. The Canton of Basle has also joined this combination.

FRANCE.—The Société Hydroelectrique de l'Isère has been authorised to start the erection of a hydro-electric station on the Isère, at St. Nazaire-en-Royans. The estimated cost of the undertaking is 20,000,000 fr., and the power expected to be obtained 20,000 H.P. Authorisation has also been given to the Société des Forges de Franche-Comté to build a dam at Bourg-de-Sirod, on the Ain, the power expected to be realised from a 44-metre fall totalling 1,812 KW. A station is also to be erected on account of the State on the Corrèze, near the village of that name. The dam, 100 metres long, will provide a fall of 166 metres, yielding 8,000 H.P.

Denney.—PROPOSED MAINS EXTENSIONS.—An estimate is to be prepared of the cost of extending the mains to Anchor Burn, Dunipace, where energy is needed for lighting and power.

Dewsbury.—RESTRICTED SUPPLY.—The capacity of the generating station is such that the Corporation has decided that for the present no further applications for supplies of energy can be entertained.

Douglas (Isle of Man).—The Committee of the Isle of Man Legislature held an inquiry on Monday last week into the application of the Douglas Electric Light and Power Co. for powers to supply electrical energy in Douglas. The application was opposed by the Douglas Corporation.

Dungannon (Co. Tyrone).—PROPOSED E.L. SCHEME.—It is suggested that electric lighting and power should be installed for the town and district, and is pointed out that the Portna Falls on the Lower River Bann would be a good source of supply for Mid-Ulster. A Committee has been appointed to deal with the question.

Elland.—Mr. W. H. Eastwood, in a general report, states that the position of the electricity undertaking is going to be eased a little by the Bill now before Parliament, and, seeing that Bill proposed reasonable safeguards in the matter of capital outlay, nothing would be gained at this stage by "rushing into the hands of the Yorkshire Electrical Distribution Co."

Ellesmere Port.—ELECTRICITY SUPPLY.—The Mersey Power Co. has informed the U.D.C. that it will request the B. of T. to proceed with its application to supply electricity in the district as if the Council's consent had been given, owing to delay on the part of the Council in arriving at a decision in the matter.

Folkestone.—ELECTRICITY CHARGES.—With reference to the Electricity Co.'s proposal to increase the charge for energy from 7d. per unit to 8d., the T.C. has advised consumers to pay 8d. only under protest. Under their order the company's maximum price is 8d., but under a deed of transfer with the Corporation, the charge is limited to 7d., and the T.C. agreed to 7½d. being allowed. The company has threatened to cut off the supply to consumers refusing to pay 8d.

Formosa.—HYDRO-ELECTRIC SCHEME.—According to a report by the United States Consul at Taiwan, the Formosan Government, in co-operation with private capital, is contemplating establishing what, it is said, will be one of the largest hydro-electric plants in the Far East, at Jitsugetsu-tan (Lake Candidius), in Nanto Prefecture, Taiwan. It is planned to start the plant during the present fiscal year, probably in August, or as soon as the Bill for the necessary appropriation for the undertaking has passed through the Diet, the Cabinet having already signified its approval of the scheme. A limited company will be organised, the Government to hand over to this company, as its share of the investment, all of the electrical industries (both immovable property and equipment) at present in its hands, the balance of the capital required to be subscribed privately. As this is not a purely Governmental undertaking, there will be no discussions in the Diet regarding expenditures, but certain matters will require the Diet's approval, and it is expected that particulars regarding the establishment and maintenance of the company will soon be made public in that body. Plans have been adopted for putting up plant, capable of developing a maximum of 130,000 H.P., and serving the whole island. Power is to be supplied for industrial purposes at about ¼d. per unit. The work of construction will take five years, and will cost £4,800,000. Capital for the undertaking will be largely subscribed by Japanese firms, having branch offices in Taihoku, and also in New York City. The engineers in charge will be Mr. Yamagata for construction, and Mr. Okoshi for electrical equipment, both of the Public Works Department of the Formosan Government. The American Consulate at Taihoku has supplied the Public Works Department with American catalogues, describing excavating, electrical, and other machinery.

Glasgow.—YEAR'S WORKING.—Although there has been no increase in the units sold by the electricity department, the revenue has increased by £60,000 over last year's total of £850,000, due to the increased charges.

Halifax.—MAINS EXTENSIONS.—It has been decided to extend the E.H.T. main at Club Lane, Ovenden Road, up Ovenden Road to Cousin Lane, and then with an overhead line to Muxenden and Muxenden Mill, at an estimated cost of £1,746, subject to Messrs. E. Armitage & Son agreeing to pay half the cost of the main.

The Committee has agreed to pay Messrs. E. Green & Son, Ltd., of Wakefield, £51, to cover the increased cost since the date of the tender, for the supply of one of the patent fuel economisers.

Sanction has been given for the supply of electrical power to the mills of Messrs. Sykes & Morley, Corporation Street.

Ireland.—The Irish Local Taxation Returns for 1917-18, show municipal indebtedness for lighting at £2,132,842. The net expenditure from revenue amounted to £8,847,366, or excluding municipal electric lighting, gas, and tramway undertakings, it was £7,618,479.

London.—FULHAM.—In factories and other similar premises where there is a consumption of not less than 12,000 units per quarter for power purposes, the charge for electrical energy supplied for lighting purposes on the same premises is to be subject to a special rebate of 50 per cent., without any further discounts.

Manchester.—YEAR'S WORKING.—In 1918 there was a surplus of £23,665 on the Corporation electricity department; this year there is a deficit of £37,602. To meet this the whole reserve fund (£28,797) has been transferred to revenue account, and £13,604 carried forward as a charge against future profits. On capital account the total outlay totals £3,495,218. The mortgage debt stands at £1,851,701. The volume of business has fallen by 5 per cent., the annual sales totalling just over 184½ million units. The average price paid for coal has risen 3s. 5d. per ton during the year.

BARTON SCHEME.—The proposal to erect a new generating station at Barton was approved by the Council in December, 1914, and borrowing powers amounting to £424,220 were then sanctioned. As a war measure, those powers were diverted for the purpose of extensions at the Stuart Street and Bloom Street stations. It is now proposed to carry out the Barton scheme, and the increased cost, which makes it necessary to borrow over a million pounds, is due not only to the present-day cost of labour and materials, but also to alterations in the design and size of plant. The Electricity Committee suggests that during the years of construction the interest on loans should be capitalised, and the sinking fund suspended. This suggestion has been accepted with some hesitation by the Finance Committee. In order that the scheme may be considered by the Government Departments at an early date, the Finance Committee raises no objection to the application for borrowing powers, but points out that if the borrowing powers are granted, another opportunity ought to be afforded so that the need for the station may be again examined before any commitments are entered into. In a report recommending the re-creation of the Barton borrowing powers, Mr. S. C. Pearce states that the provision of 50,000 KW. of new plant, which is the amount proposed, will probably suffice for the department's requirements over a period of not less than seven, or more than ten, years. If the proposal to

capitalise the interest and suspend the sinking fund is adopted, the total annual payments will amount to £134,550, but within the next six years recurring capital charges to the extent of £176,537 will expire, and very considerable economies are expected from the modern character of the new plant. The over-all efficiency (coal to electrical energy) of the existing Stuart Street station is 11·55 per cent., but it is confidently anticipated that the new Barton station will show an over-all efficiency of 18 or 20 per cent.

Navan (Co. Meath).—The Town Tenants' and Vigilance Committee has asked the Irish L.G.B. to withhold sanction of a proposal to expend £1 250 on new electrical plant for the town on the ground that the existing plant is satisfactory.

Portrush (Co. Antrim).—Extension of Time.—The B. of T. has extended till August 15th, 1920, the time for laying the mains, &c., in connection with the electric lighting scheme, a loan of £10,500 for which it is proposed to obtain from the Belfast Banking Co.

Rotherham.—Year's Working.—The annual report on the working of the Corporation electricity undertaking for the year ending March 31st last, shows that the units sold have increased 14·6 per cent. during the year; the average price obtained per unit sold was 1·03d. The total receipts were £108,873, against £78,013; gross profit, £20,514, against £19,701; and capital charges, £17,999, against £14,139, and £2,514 carried to appropriation account. The Electricity Committee has recommended that the basic rate for the supply of electricity be reduced from 1½d. to 1d. per unit.

South Africa.—At the last meeting of the Cape Town T.C., the city electrical engineer reported that the damaged stator which had been sent to England for repairs, was due to arrive in about a week's time. Portions of the 11,000-volt cable (ordered two years ago) for augmenting the supply to the Government railway workshops at Salt River and Southern Suburbs, had arrived, and, assuming that the transformers were received during the next three months, the department should be in a position to meet the demands for lighting, very shortly.

Stockport.—Price Revision.—The charges for electricity are to be increased by 10 per cent. to all consumers, with the exception of those having special agreements.

West Hartlepool.—E.S. Bill.—The T.C. has decided to support the recommendations of the I.M.E.A. and the Conference of North-East Coast Municipal Authorities possessing electrical undertakings in respect to the Electricity Supply Bill.

Wigan.—L.G.B. Inquiry.—A L.G.B. inquiry was held by Col. Ekin at Wigan on Wednesday, last week, into the application of the Corporation to borrow £101,250 for extension of plant at the electricity works.

Worcester.—Year's Working.—The report on the working of the electricity department for the year ending March 31st last, shows a total income of £32,235, compared with £31,394 for 1917-18. The cost of generation and distribution amounted to £19,138, leaving a gross profit of £12,951, equivalent to 6·3 per cent. of capital expended and 17·7 per cent. on capital outstanding, which amounts to £73,320. After payment of interest, £4,423, redemption of capital, £6,281, and income-tax, £439, there remained a profit of £1,808. During the year interest and sinking fund charges were reduced by £1,152. The net profit was carried forward to the appropriation account, of which the balance available was £3,182, and it was recommended that this sum be retained as a reserve against the anticipated loss on the current year's trading; £27,095 was expended on new plant and cables since 1914, and, in spite of this, the outstanding debt has been reduced from £91,271 to £73,319. With the exception of minor re-arrangements, no new works were undertaken at the Hylton Road works. During the year 615,703 units, against 1,000,718, were generated at the Powick water-power works, the output of which depends entirely upon the water flow of the river Teme. The total increase of demand equals the equivalent of 6,209 30-watt lamps, against 15,708 30-watt lamps in 1917-18; 21 new consumers were connected and extensions made to 59 installations. The total output for the year was 4,294,168 units, against 4,637,269; the total works cost being 1·04d. per unit sold, against 0·77d. last year.

TRAMWAY AND RAILWAY NOTES.

Blackburn.—Year's Working.—The annual report showed a profit of £6,650, against £6,970 the previous year. Out of this profit came £3,000 for arrears in permanent-way improvements. The receipts for the year were £94,992, against £80,361, and the expenses increased from £53,231 to £69,020. Wages increased by £5,715, and since the close of the financial year further increases have been granted involving £7,000.

Blackpool.—Contract System.—The tramway contract ticket-holders are to pay more, and 3,000 people are affected. At present a contractor can, for £3, travel on almost all routes. The new adult "all routes" price is £8. Mr. Furness (tramway manager) submitted that so far back as 1915 there was a loss of £2,000 on the contract system. During the last seven years the amount of subsidy to contractors in meeting working expenses has been £17,843. Last year the amount was £5,588.

Bradford.—Track Repairs.—Work on the renewal of the Manchester Road tramway track will be commenced on June 28th. Owing to delay arising between the Post Office and the B. of T. in connection with the removal of underground telegraph cables, it is not yet practicable to commence work on the renewal of the Thornton Road section.

Continental.—Spain.—There has been formed at Madrid a company styled Ferrocarril Electrico del Guadarrama, with the object of building and working an electric railway from Cercedilla to the port of Navacerrada. The capital is said to be subscribed by Madrid and Argentine capitalists, and the building of the line is to be begun forthwith.

Belgium.—A Commission was appointed in 1916 to investigate the advisability of electrifying the Belgian State Railways, and an interim report was issued advocating the electrification of a considerable portion of the lines. When the Belgian Government was reinstated in its capital, a new Commission was appointed to go over the work of the previous Commission, and to investigate, not only the electrification of the railways, but also unifying the supply of electricity for all purposes all over the country. This Commission has recommended the immediate preparation of a scheme for the electrification of the Brussels-Antwerp line and of the railways in the immediate neighbourhood of Brussels, and its next task is to inquire into the question of co-ordinating existing electric supply undertakings and the erection of new super-power stations.—*Times Engineering Supplement.*

Italy.—On June 4th, a tramway accident at Rome resulted in two deaths and a number of injuries. The accident was caused by a failure of the brakes. The tramwaymen immediately went on strike as a protest. The municipal tramwaymen resumed work in the afternoon, but the employés of the Società Romana, to which the vehicle belonged, remained on strike. The men assert that this is the only way left to them of protesting against the condition of the tramways, regarding which they have complained many times. The company contends that it is the inevitable result of the war. The men, on the other hand, assert that the company could quite well maintain all the necessary material in good order, but will not go to the expense which that would entail in view of the fact that the whole tramway system of Rome will eventually come under the municipality.

Doncaster.—Extensions.—Plans and specifications are to be prepared for doubling the tramway track on the Balby route and at St. Sepulchre Gate. The plans will be subject to B. of T. approval.

Fleetwood.—Car Licences.—A case raising an interesting issue, and concerning the licensing of cars, drivers, and conductors of the Blackpool and Fleetwood Tramroad Co., was adjourned at Fleetwood Police Court last week. The company takes the attitude that there is no obligation on its part to take out licences in the Fleetwood district. Fleetwood Council claims the right to licence cars, &c., and to draw the fees.

Glasgow.—Year's Working.—The approximate figures of the year's working to May 31st, of the Corporation tramways are:—Income, £1,527,056, as against £1,404,110, an increase of nearly £123,000; passengers carried, 464,000,000, as against 430,946,566.

Depreciation.—Reporting on depreciation, the general manager of the tramways states that at the end of the last financial year the amount in hand for renewal of track was £206,887. If the Committee continued to set aside £400 per mile of single track, which was equal to £78,511 per annum, it would have at its disposal by the end of the year 1922-23 the sum of £599,442. The expenditure in renewals this year would be £25,000, but for the next four years it was hoped to spend about £200,000, so that by May 31st, 1923, £825,000 would have been expended. This would leave a shortage of £225,000, which must be made up during this and the next four years. Meantime, he suggests that the Committee shall set aside £700 per mile instead of £400. This means an increase in the annual sum to meet renewals of £58,879. The sums to be set aside for this year would be as under:—Permanent way, £137,390; power plant, £14,164; cars, £18,030; electrical equipment of cars, £9,878; other rolling stock, £2,760; Clydebank bridges, £500—a total of £182,722.

Halifax.—Wages.—Upon the request of the Amalgamated Association of Tramway and Vehicle Workers, that, in accordance with the Engineers' Award, time and-a-quarter should be paid for night work and double time for Sunday work, to the shed staff at the tramway depôt, the Tramways Committee has recommended that skilled and semi-skilled men in the tramway engineer's department be paid the same rate for Sunday work, in accordance with the agreement between the representatives of the Municipal Tramways Conference, Tramways and Light Railways Association, and the National Transport Workers' Federation, on March 21st last.

Messrs. Courtaulds, Ltd., have withdrawn their offer to purchase the Highroad Well tramway shed, and an offer by Messrs. Wm. Acquith, Ltd., to purchase the land and buildings, comprising the old tramway depôt, for £6,500, has been accepted.

Lancaster.—The T.C. has agreed to the closing of a part of the tramway track from the centre of the town to the railway station. This portion was constructed 16 years ago, at a cost of £9,000, and never had paid, and would cost £6,000 to put in order.

Liverpool.—Proposed Improvements.—The Special Reconstruction Committee recommends extensive improvements in the tramway facilities at the Pier Head. It is proposed to offer premiums of 1,000, 500, and 250 guineas for the best schemes.

London.—L.C.C.—The Highways Committee reports, with reference to the increases in fares on the Council's tramways; that one of the principal reasons for the increases was the institution of the 48-hours' week and other concessions involving an increased annual expenditure estimated at £360,000, or nearly £1,000 a day. In 1914 the total wages bill for the tramways undertaking was £1,102,220 for operating 59,209,289 car-miles. For 1919-20 this sum, it is estimated, will be increased to £2,421,250 for a car-mileage of 53,000,000. In order that the Council's tramways may pay during 1919-20, it will be necessary to raise over £1,000,000 more than the revenue for last year, which was approximately £3,680,000. The Highways Committee considers that a revision of the fares is necessary to balance expenditure and revenue.

CHILDREN'S FARES.—Commencing on July 1st, children's fares are to be reinstated on the L.C.C. tramway system. They will be approximately half the existing adult fares.

L.C.C. EXTENSIONS.—The Standing Orders Committee of the House of Commons having decided against the suspension of the Standing Orders in the case of the L.C.C. Tramways and Improvements Bill, which cannot therefore be proceeded with, it is proposed to urge its necessity by deputation to the B. of T. and L.G.B. Steps are being taken to proceed with the delayed construction of the authorised tramways in High Street and East Hill, Wandsworth, and from Lee Green to Eltham; the supplemental estimates put forward are, respectively, £20,370 and £53,675.

TUBE TRAINS.—The B. of T. states that the additional carriages recently placed in service by the tube railways during the mid-day hours number 119. Since May 30th, 70 extra coaches have been running on the District Railway on the mid-day service and three additional six-coach trains have been in operation on the Central London Railway. The Bakerloo has increased its three-car trains, running at 2½ minutes' intervals, to five-car trains; the City and South London has accelerated its service from one train every 4¾ minutes to one every 3¾ minutes, and the 5 and 2½ minutes' intervals on the Hampstead Tube have been shortened to 4 and 2 minutes respectively. On the Piccadilly Railway a three-car train, each 2½ minutes against each 3¾ minutes, will be run. These arrangements involve an additional 243 cars during the mid-day hours.

Lourenco Marques.—THREATENED STRIKE.—The tramwaymen gave notice to strike at the end of May. They demanded an increase equivalent to 54½ per cent., which the company refused to consider. The demand was for an increase from 11s. to 17s. daily, which meant an increased expenditure of over £4,000 a year on the tramway service, which, the company declared, had never paid working expenses.

Malvern.—Mr. C. C. Broad has applied to the Light Railway Commissioners for an Order reviving the powers granted by the Malvern (Funicular) Light Railway Order, 1911.

Rotherham.—YEAR'S WORKING.—The annual report on the working of the Corporation tramways shows total receipts of £104,207, compared with £82,959 last year; gross profit, £20,702, and total surplus, £2,797. Receipts per car-mile had advanced from 18·43 per cent. to 25·09 per cent. Power expenses had increased 31·97 per cent., traffic expenses 46·37 per cent., and repairs and maintenance 51·56 per cent. The total operating costs had increased 34·68 per cent. Passengers carried in 1917-18 numbered 18,095,654, against 17,833,753 this year. There was a deficit of £91 on the Maltby trolley system and of £2,621 on the petrol routes.

Wharfedale.—INADEQUATE SERVICE.—Strong protests have been made against the alleged inadequate service of railless cars provided in Wharfedale by the Leeds Tramways Department. Burley, it is said, is sometimes left without service altogether, owing to divergence of vehicles to the Otley route.

TELEGRAPH AND TELEPHONE NOTES.

Automatic Telephones.—Sir William Slingo, late Engineer-in-Chief to the Post Office, is reported to have said that the British telegraph system was the best in the world, and he considered that in the matter of automatic telephones this country was ahead of America. He was shortly going to America in a consultative capacity to the American Government in connection with the future development of the telephone in that country.

A trial of automatic telephone apparatus is being made at several Parisian post offices—notably in the Boulevard des Italiens and in the Place de la République.

Cable Interruptions.—Mr. Illingworth stated in the House last week that the cables to Gibraltar had been restored, but there were faults in two of them which prevented their being used to their full extent. The American Pacific cable was still interrupted, but cable ships were engaged on its repair, and it was hoped that the work would be completed in a few days. The restoration of this cable would to some extent relieve the congestion to the Far East.

The Direct Spanish Telegraph Co. gives notice that cable communication with Spain "via Spanish" has now been restored.

German Cables.—A correspondent of the *Frankfurter Zeitung* writes in reference to the German cables to Spain and North America from Emden, that these were cut at the beginning of the war, and later were reconnected with France and England, and utilised by the Allies. If the Allies actually retain them after Peace, it will mean a severe blow to German overseas trade, as the American cables forwarded over 3,000 cables daily, 90 per cent. of which were of a commercial nature, and even five minutes' delay in these telegrams would prejudice German traders seriously in competition with other nations. The political disadvantages of exclusion from direct communication with America, and the danger of commercial spying at the foreign transmitting place, need hardly be alluded to. Even if the Allies allowed new German cables to be laid, it would hardly be possible to arrange this, as fresh concessions would be difficult to acquire, new cables would cost 150 per cent. more than before the war, the capital required could hardly be found on the German market, and, finally, the raw materials are not available. This demand of the Allies must, therefore, be resisted to the utmost.

Monte Video.—The threatened strike of telephone operators has been averted by the granting of increases in salaries, the minimum monthly salary of operators being raised from $23 to $30 Uruguayan gold.

Red Cross Free Cables.—The British Red Cross Society and the Order of St. John have gratefully accepted the proposal of Sir John Denison Pender, that the Eastern and Associated Telegraph Co.'s concession with regard to free cable service shall continue to the end of the year.

United States.—The Western Union Telegraph Co. state that arrangements are under way with the Western Telegraph Co. of Great Britain for a direct cable between the United States and Brazil, thence down the eastern coast of South America. The new scheme involves the laying of 3,200 miles of new cable. The connection between North and South America will be from Miami (Florida) to Belem (Brazil), *via* Barbados. The work is expected to be completed in six months.

Strikes of Western Union Telegraph employés in 10 Southern States have been called, but all the operators are not responding to the call. The telegraphists and electrical workers "out" in Atlanta (Georgia) are demanding the sanction of a general strike.

A national strike of telephone workers, involving operators, maintenance constructors and repairmen, is to begin at Cleveland, Ohio, on June 16th. The order is due to the strike of commercial telegraphists, which was to begin on June 12th. The telephone employés are making similar demands, viz., recognition of the Union and the right of collective bargaining, and the abandonment of discrimination in discharging Union men. In the event of a big national strike of telegraph and cable operators, the Government will use military forces if necessary to keep the wires and cables open for Government business.

Wireless Telegraphy.—According to the daily Press, the Handley-Page aeroplane now being assembled at St. John's, Newfoundland, for the trans-Atlantic flight, on June 2nd picked up wireless calls from English, German and Italian land stations 4,000 miles distant, whilst its wireless apparatus was being tested.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Australia.—SYDNEY.—June 23rd. Municipal Council. One 60-ton electrically-driven overhead travelling crane. Electric Lighting Department, Town Hall, Sydney.*

Bethnal Green.—June 19th. Electricity Committee. L.T. cables and pipes, section pillars, house services, and roadwork. (June 6th.)

Birkenhead.—July 28th. B. of G. Installation of internal telephones. (See this issue.)

Eccles.—June 23rd. Electricity Committee. Supply and laying of three-way underground ducts; supply and drawing-in 2,733 yd. of ·20 sq. in., E.H.T., three-core cable. (May 30th.)

Paris.—July 10th. Administration des Postes et Télégraphes. Supply of multiple commutator switchboards. Particulars from Direction de l'Exploitation Téléphonique, 4, Bureau, 103, Rue de Grenelle, Paris.

Tasmania.—LAUNCESTON.—July 28th. City Council. Sub-station equipment, battery, reversible booster, switchgear, &c. City Electrical Engineer.

Manchester.—June 17th. Electricity Committee. 10-ton overhead travelling crane. Secretary, Electricity Department.

June 20th. Electricity Committee. Coke or coke breeze during 12 months. Secretary, Electricity Department.

*A copy can be seen at the Inquiry Office of the Department of Overseas Trade (Development & Intelligence), London.

West Hartlepool.—June 17th. Corporation. H.T. switchgear; two 1,500-KW. transformers; two 500-KW. rotary converters; one cooling tower. (May 30th.)

Woolwich.—June 18th. Electricity Department. One 5,000-KW. steam turbine, with condensing plant and accessories. (June 6th.)

CLOSED.

Bolton.—The Tramways Committee.

Bromilow & Edwards.—Two chassis made by the Associated Equipment Co., to be used for the tower wagons.

Bradford. — Electricity Committee. Two additional 360-K.V.A. transformers, Ferranti, Ltd.

Tramways Committee.
14 point tongues, Hadfields, Ltd., £98.
15 tons ½-in. round mild steel rod, Crossley & Davenport, at £21 per ton

Hammersmith.—B.C. :—

350 yd. 2 sq. in. L.T. cable :—

Pirelli General Cable Works, Ltd. ..	(recommended)	**£170**
Western Electric Co., Ltd.		182
Callender's Cable & Construction Co., Ltd.		184
B. I. & Helsby Cables, Ltd.		184
W. T. Henley's Telegraph Works Co., Ltd.		189
Macintosh Cable Co., Ltd.		204

Maintenance of storage battery :—

Premier Accumulator Co., Ltd.—£88 per annum for a period of five years (the previous contract just expired was for £45 per annum).

FORTHCOMING EVENTS.

Physical Society of London.—Friday, June 13th. At 5 p.m. Special general meeting. Papers on "A Comparison of the Wave Form of the Telephone Current Produced by a Thermal Detector and a Rectifier in Heterodyne Reception," by Mr. B. van der Pol, and "The Magnetic Properties of Varieties of Magnetite," by Messrs. E. Wilson and E. F. Herroun.

National Foremen's Association, Engineering, Shipbuilding and Allied Trades (West London Branch).—Saturday, June 14th. At the Norfolk Arms Hotel, Burwood Place, Edgware Road. Ordinary meeting.

Incorporated Municipal Electrical Association.—Annual convention :—
Wednesday, June 18th. At 10 a.m. At the Town Hall, Ipswich. Reception by the Mayor of Ipswich. Presidential address by Mr. F. Ayton, Engineer and Manager, Ipswich Corporation E.S. and Tramways Department. Paper on "The Whitley Report: the Application of its Recommendations to the Electric Supply Industry," by Ald. W. Walker.
Thursday, June 19th. At 10 a.m. At the Spa Pavilion, Felixstowe. Discussion on "Electric Transmission," to be opened by Mr. S. L. Pearce. Paper on "The Rating of Electric Supply Undertakings," by Baillie W. Smith.
7.15 p.m. At the Felix Hotel, Felixstowe. Annual dinner.
Friday, June 20th. At the Spa Pavilion. Annual general meeting.

Industrial Reconstruction Council.—Tuesday, June 17th. At 6 p.m. At the Institute of Journalists, Tudor Street, E.C. Conference on "Some Methods of Regulating Wages," to be opened by Mr. J. Baker, Iron and Steel Trades Confederation.

Society of Technical Engineers (Woolwich Branch).—Friday, June 20th. At 6 p.m. At the Shakespeare Hotel, Powis Street, Woolwich. Discussion on "The Third Party Policy."

NOTES.

British Scientific Products Exhibition.—On account of the very large number of applications that have been received by the Organising Committee of the forthcoming Exhibition of British Scientific Products, all the space available at the Central Hall, Westminster, has now been allotted, and no further applications can be considered. The Exhibition will be open to the public from July 3rd to August 5th. Its scope will be more extensive than was possible at last year's display, when war conditions made it necessary to withhold from public view much of the scientific and technical work carried on in Great Britain. Striking testimony will be furnished of the enterprise of British manufacturers, and the uses they have made of science and invention in new industries and the development of old.

The Electric Vehicle Committee of Great Britain.—Mr. R. A. Chattock, who has been chairman of the Committee since its formation in 1913, and who in that capacity has done much valuable pioneer work in promoting the use of electric vehicles, has been compelled, owing to the pressure of other work, to resign the position, although he will continue to serve as a member of the Committee.

At the last meeting of the Committee, held on May 9th, Mr. Chattock's resignation was received with regret, and a resolution was passed thanking him for his services. By a unanimous vote of the Committee, the hon. secretary (Mr. F. Ayton) was elected chairman for the year ending March 31st, 1920. Mr. Shrapnell-Smith was re-elected vice-chairman, and Mr. J. Christie was re-elected hon. treasurer. Mr. Ayton will continue to hold the position of hon. secretary, to which he was re-elected.

A Special Committee to investigate the question of the most suitable quality of rubber to employ for solid tires for electric vehicles has been appointed jointly by the Electric Vehicle Committee and the British Association of Rubber Tire Manufacturers.

The Committee's publication, "The Electric Vehicle," will appear monthly, commencing with the June issue.

Strikes.—The building trades of Melbourne have struck and the seamen's ballot is proceeding, but the majority of men are absenting themselves. Adelaide is imposing drastic light and power restrictions, as the city only possesses three weeks' supply of coal. Melbourne coal lumpers have struck, and restrictions have had to be imposed on the use of gas and electricity. It is feared that there will be a repetition of the great strike of 1917. As a result of the coal shortage factories are closing down wholesale. Some manufacturers have installed oil engines, and are thus enabled to continue work. Mr. Watt, acting Premier, is to submit to Parliament a Bill to amend the existing arbitration legislation.

At Toronto the general strike has come to an end, leaving the metal trades to continue their fight alone. At Winnipeg there are also signs of some workers returning, although the deadlock continues. At Vancouver a general sympathetic strike is in progress, while demonstrations have been held at Manitoba. At Montreal employés of Canadian Vickers, Ltd., have gone on strike for a 44-hour week.

At Paris there are some signs of improvement in the labour position, although the strikes continue. Traffic workers declare they will not return to work until they have obtained full satisfaction. Employers are equally firm. Large numbers of workers are idle in other parts of France.

At Rome workers, including tramway employés, are idle through strikes. The Italian Press lays the blame upon the delays of the Peace Conference.

A general strike has commenced among the Danube and Hungarian steamship companies' workmen. All passenger and freight traffic on the Danube is stopped.

In Norway the Minister of Defence has threatened to use military means for the maintenance of social order.

Radium Bombardment.—Lecturing last Friday at the Royal Institution on "Atomic Projectiles and their Collisions with Light Atoms," Sir Ernest Rutherford said he thought he had obtained some evidence of the disruption of atoms by the impact of the swift alpha-particles shot out by radium C. His grounds for this view are roughly as follows: When one of these alpha-particles hits the nucleus of a light atom like that of hydrogen in a head-on collision, the atom is pushed on a certain distance more or less in the line of motion of the particle. A heavier atom, like that of nitrogen, is not pushed so far; yet when the experiment is tried on nitrogen a few atoms are found that go as far as hydrogen atoms, and in fact appear to be hydrogen atoms. The possibility that the hydrogen comes from external sources seems to be disproved by the precautions taken, and in that case it must come from the nitrogen. The lecturer was, therefore, led to the speculation that the nucleus of the nitrogen atom was made up of three atoms of helium and two of hydrogen, and that the hydrogen which made its appearance in his experiments was sent off the nucleus of the nitrogen atom by the impact of the alpha-particle.—*The Times.*

Chief Technical Assistants' Association.—The annual dinner of the Association was held on May 31st, Mr. J. M. Parker (Croydon), the chairman of the Association, presiding. After the loyal toasts had been duly honoured, the chairman, in proposing the toast of the C.T.A.A., stated that during the past year they had discussed some very useful and practical papers, relating to the plant under their charge, which were of undoubted benefit to all, and they had an excellent programme for the ensuing year. He recollected that the past chairman, Mr. H. F. J. Thompson (Battersea), expressed the hope at their last annual dinner that the various protective associations would ultimately combine; it was a pleasure to recall that during the past year they had joined forces with the E.P.E.A., and he hoped there would be further amalgamations. He emphasised the fact that any good work which was accomplished by an association was achieved by the energy and public spirit of its members, and he hoped that all of them would, to the utmost of their abilities, further the interests of the C.T.A.A. and those with whom they were associated. The position was very critical, perhaps more so than most of them were aware, and attempts had already been made to discredit and break up their protective organisation. While it was true that there were not many bad employers, still there were always plenty who were prepared to shelter behind the bad ones, and seize any advantage that could be gained by their activities. The policy of their protective association was sound, and its record would bear investigation. It was up to every one of them as the chief technical assistants of their various undertakings to see to it that as far as lay in their power, right decisions were taken in all matters pertaining to the welfare of the staffs, for only thus would the interests of the industry to which they had devoted the best years of their life be safeguarded. An excellent musical programme was provided by Mr. Bradshaw (Islington), ably assisted by several members of the Association, and a most enjoyable evening was spent.

Imperial Communications. — At a meeting of the Industrial Group in the House of Commons, Colonel Archer Shee submitted a statement on the post-war importance of Imperial communications, with special references to cables and wireless. He also emphasised the necessity for shipping subsidies, with a view especially to facilitating cheap third-class passages abroad. The British Commonwealth Union has decided to set up immediately a special Parliamentary Committee to inquire into these two matters and to prepare a report.

Institution and Lecture Notes.—Institution of Electrical Engineers.—The Secretary of the Institution is informed that demobilised officers attending the Conversazione on the 25th inst. are permitted by the authorities to wear uniform on that occasion.

The annual dinner is to be held on Thursday, June 26th. Early application for tickets should be made, in order that the necessary arrangements may be effected.

Mr. J. F. Neilson occupied the chair at the summer meeting of the SCOTTISH CENTRE of the Institution, held at Aberdeen on Friday last. There were 64 visitors, and a total attendance of about 130. The members were accorded a civic welcome by the Lord Provost, Sir James Taggart. Mr. C. H. Wordingham, C.B.E., President, in the course of an address, said the electrical industry had an extraordinary fascination for the legislator, and that it was a dangerous experiment to put any industry largely under the Government. Prof. Magnus Maclean (Glasgow) delivered a lecture on "Water Power," in which he emphasised the important part it could play in developing the Highlands, where the power was less used than it was a century ago. Mr. A. Newlands, chief engineer, Highland Railway Co., said there was a strong determination on his part to secure such an amount of power as existed for his own particular need. The members were entertained at luncheon by the Electricity Committee of the Town Council, and spent the afternoon sight-seeing, visiting Rubislaw granite quarries, Donside paper mills, and the Corporation electricity works.

Society of Engineers.—At a recent meeting of the Status Committee of this Society, it was agreed that members should increase their fees (other than those charged as a commission) by 33⅓ per cent., and that the fees mentioned in "Professional Practice in Engineering (Part I), Consulting Engineers," should be altered accordingly.

At the NEWCASTLE ROTARY CLUB, on May 30th, Mr. W. F. T. Pinkney, of the Newcastle Electric Supply Co., gave an address on "Electricity and Public Service." It was curious, he said, that there still were people who regarded electricity as something of a luxury. He believed the universal use of electricity would come, but it might be a long time before electricity would be available in every part of the country. No form of energy was so well adapted to labour-saving as electricity. The introduction of electricity more largely into the housing schemes would, he thought, lead to cleaner homes.

Industrial Meetings on Tower Hill.—The Industrial Reconstruction Council is holding dinner-hour open-air non-party meetings at Tower Hill, every Monday (commencing 16th inst.), at 1 o'clock. At these meetings the policy of adopting Whitley Councils—or Trade Parliaments—in each industry, will be advocated as one of the best constructive methods of increasing productivity, solving Labour problems, and bettering the lives and conditions of wage-earners.

Sales of Government Property.—The progress made in the sale of surplus Government property under the direction of the Disposal Board, Ministry of Munitions, is indicated by the fact that the value of the stores sold up to date amounts to upwards of £107,000,000. We note that the Controller of Telephones, Telegraphs and Electrical Instruments has visited Belgium, with the result that sales will be considerably accelerated. Of the several sales authorised by him, one includes that of 150,000 lamps, and he has also arranged for a quantity of samples of captured or surplus material to be on view at the Agricultural Hall, Islington.

British Oil.—The Minister of Munitions has issued a licence to the Oilfields of England, Ltd., to search and bore for, and get, petroleum, near Newark. The licence, which is the subject of a White Paper, is to continue in force for two years. The payment of any royalty is distinctly forbidden without the consent in writing of the Minister, and all information of boring is to be placed at the disposal of the Minister. It is also provided that if the Government desires to acquire the boreholes, workings, or plant, these shall be transferred at a price to be determined, the Lord Chief Justice of England to be arbitrator in disagreement.

Mine Explosion.—It is feared that 100 men lost their lives in an accident which occurred last week, near Wilkesbarre, Pennsylvania, to a train carrying men into the workings of a mine tunnel under construction. The train was drawn by an electric locomotive. The overhead-trolley wire broke, and the sparks exploded a car-load of blasting powder at the end of the train. Hardly a man in the train escaped, and as fire broke out at once, filling the tunnel with sulphur fumes, rescue work was rendered very difficult.

Educational.—The *Times* states that 10 new £200 scholarships enabling American scientific students to study in Swedish Universities have been founded. Funds are being raised in Sweden to send 10 Swedish students to the United States.

Inquiries.—Agents of the Hawkins-Everett lightning arrester are asked for.

French Water Power.—According to Mr. Eugène Schneider, President of the Iron and Steel Institute, the hydraulic power available in France in 1914 was 750,000 H.P., and in 1918, 1,500,000 H.P.; installations in course of realisation or under consideration amounted to 4,500,000 H.P. The total power of known waterfalls was 9,000,000 H.P. If it were reckoned that 1,000 H.P. hydro-electric saved 10,000 tons of coal per annum, the falls which were to be worked represented the equivalent of 30,000,000 tons of coal, and the future total power about 60,000,000 tons per annum.

The Decimal Association.—The annual report of the Decimal Association for the year 1918-19 reviews the progress of the decimal coinage movement, which is being investigated by a Royal Commission; Mr. H. Allcock gave evidence before the Commission on behalf of the Association. Many public bodies have passed resolutions advocating this reform, as well as the adoption of metric weights and measures. A canvass of members of Parliament, Trade Unions, and Chambers of Commerce showed an almost complete absence of opposition to these reforms. A lecture campaign is being prepared by Mr. E. C. Barton, who reports that in every town visited he finds enthusiastic decimalists. Educational authorities are taking steps to improve the methods of teaching the metric system and decimals. A notable departure has been the establishment of a quarterly journal, the *Decimal Educator*, as the organ of the Association, which achieved a marked success. Provincial branches are being founded. In Canada and Australia the movement is making progress, and in France and Italy the early adoption of the metric system and decimal coinage by Britain is urged as essential to the development of trade. The Russian Government is reported to have resolved upon the adoption of metric weights and measures, and the United States Section of the International High Commission declares that the general use of the metric system in trade, especially with Latin-America, is of the first importance. The principal engineering institutions of the United States, with the exception of the Society of Mechanical Engineers, have decided in favour of the metric system. In Germany, after this year, the metric system will be obligatory in the textile trades, and in Japan the compulsory adoption of the system is contemplated, while the Chinese Ministry of Communications recognises the necessity of the reform, which is to become operative at the end of next year. The Decimal Association has gained largely in strength and financial resources during the year, and is about to embark on a more vigorous propaganda. The address of the Association is 44, Finsbury Pavement, E.C. 2.

Coal, Gas, and Electricity Rations.—The Controller of Coal Mines announces that it is necessary to continue the rationing of coal, gas, and electricity for household fuel and lighting, for a further period. It is, however, proposed to modify the present order to the extent that consumers of less than 5 tons of coal in the year, and 12,500 cb. ft. of gas in any quarter, or 400 B.T.U. of electricity in any quarter, will not be subject to assessment. They must, however, be registered with their coal merchants for the supply of coal. A revised Order which will take effect from July 1st next, will be issued during the present month. In the meantime the following memorandum is issued for the information of the public:—

Anthracite, coke and patent fuel will be exempted from the Order for the time being.

All consumers of coal must register with coal merchants for their supplies. Present registrations will be valid unless notice to the contrary is given by either consumer or merchant.

The present assessments are current for a year from various dates commencing with October 1st, 1918. In the case of consumers over the quantities named above, the assessments will be renewed for the same annual quantity for 12 months from July 1st, 1919, and the balance of the old assessments cancelled.

New certificates will be issued to all present holders of certificates for 12 months' supply, and it will not be necessary to make application for the certificates, except in the case of new consumers or of those who, owing to a change in the basis upon which the original assessment was made, desire a modified assessment.

The new assessments and certificates will date from July 1st, in order to enable private consumers, so far as coal may be available, to stock on account of the coming year's allowances. Immediately on the issue of the new Order arrangements will be made to enable this to be done during the months of July, August and September.

The supply of fuel already made under any existing certificates in respect of the period subsequent to June 30th will be treated as a supply on account of the New Year's allowances.

The conversion equivalents of gas and electricity in terms of coal will be fixed at:—18,750 cb. ft. of gas to the ton of coal; 1,000 B.T.U.'s of electricity to the ton of coal.

The control of maximum prices for the sale of coal will be rigidly enforced.

In order to simplify some of the machinery and provisions of the present Order, the special Local Fuel and Lighting Committees will be discontinued, and, in the ordinary course, the control of the Local Fuel Overseer will, subject to the directions of the Controller be left to the local authority—except in the Metropolitan Division, which will continue under the immediate supervision of the Household Fuel and Lighting Branch of the Coal Mines Department.

Economy in the consumption of coal still remains vital to the national interests. If the output of coal in the near future will allow a relaxation of these restrictions the Local Fuel Overseer will be authorised from time to time to receive applications for such increased allowances as any increase in the supplies of coal may justify.

A German "Technical Supplement."—An announcement recently circulated in the German technical Press, relates to the publication in Germany of a technical review of the foreign Press. The German Review was originally published as a confidential war service under the authority of the Ministries of War and Education, and presumably with the co-operation of the Society of German Engineers. The undertaking is significant of the importance attached to the organised provision of technical information in Germany.

Appointments Vacant. — Lecturer in engineering drawing (£350 + bonus), for the Manchester College of Technology; assistant in the Government Railway and Electricity Department, Zanzibar (£300); electrical testing superintendent (£300), for the Bradford Corporation Electricity Department; cable jointer (70s.), for the Corporation of Ayr Electricity Works; lecturer in electrical engineering (£150 to £195 + 15s a week war bonus), for the L.C.C. Technical Institute, Paddington; junior shift engineer (73s.), for the Burnley B.C. Electric Lighting Department; electrical engineer (£600) for the South Shields Corporation. See our advertisement pages to-day.

Fatalities.—An inquest was held at Stourton, last week, respecting the death of Fredk. Arnison (16), general labourer, of Leeds, who was killed at the Yorks. Copper Works. The evidence showed that two brass tubes which the youth was carrying over his shoulder came into contact with the switchboard of the electric plant, and he immediately fell to the floor dead. A representative of the firm said that bogies were provided on which tubes might be carried, but there was no rule that the tubes should be carried on them. The switch was placed at the top of a short column, and was out of the way in the ordinary course. Normally, it could be touched and no shock received, but when the tube the lad was carrying touched the switch he formed one earth. To complete the circuit another earth was needed. This was found in an accidental earth that occurred in the press-house on that particular day. It was explained that these earths occurred in the best systems from time to time, and to avoid them a search was made once a fortnight. It was stated that previous to this there had only been one fatal accident at the Yorkshire Copper Works in 30 years, and arrangements had been made to prevent a recurrence. Verdict, "Accidental death."

The B.A. Meeting in 1921.—It is proposed to invite the British Association to hold its meeting at Edinburgh in 1921.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.

Central Station and Tramway Officials.—At the Barrow Town Council meeting on June 2nd, the Electricity Committee minutes contained a copy of a letter from Mr. H. R. Burnett, borough electrical engineer, to the Mayor respecting "grosely inaccurate and misleading statements" made at the Council meeting on April 7th, when the question of his salary was under consideration. The statements referred to mis-stated the amount of Mr. Burnett's advances in salary. Mr. Burnett had previously supplied the Committee with information showing that the *average* salary, with bonus, paid in 22 undertakings comparable with Barrow was about £900 per annum, and in nearly one half of these, and a number of smaller undertakings, the salary now being paid or promised was £1,000 per annum, or over. At the end of his letter to the Committee, Mr. Burnett stated:—

> Whilst the Association of Municipal Electrical Engineers, which has applied to you on my behalf, is most anxious to avoid taking any extreme measures to enforce their demands, I think it right that the Council should realise that it intends to insist upon Corporations paying its members reasonable salaries for the positions which they occupy, or agreeing to refer the question to arbitration. In any action which the Association may decide to take, it will, I have no doubt, not only have the support of all its members, but also of the Electrical Power Engineers' Association, to which every member of the technical staff of your electricity department, and a very large proportion of the assistant engineers throughout the country, belong. If, therefore, the Council persists in its refusal to grant the reasonable request which has been made by the Association, the responsibility for any difficulty which may arise in the administration of your electricity department must rest with the Council.

When the matter was before the Council, the Councillor who made the remarks mentioned above admitted that some of his figures were wrong. Respecting the threats in Mr. Burnett's letter, he (Coun. Whinnera) believed that the works could be carried on if the technical staff came out.—Coun. Barrie thought the position was a very unhappy one, and Coun. Basterfield contended that in dealing with officials' salaries the Council should remember the arguments used when the question of wages was being discussed, namely, that Corporation workers had a week's holiday with wages and a continuous employment for life. That applied also to officials.—Coun. J. H. Brown asked if provision was being made to staff the electricity works in the event of the technical staff and borough engineer going on strike.—Coun. Barrie replied that the Committee understood that the matter was not yet finished. Mr. Burnett was going to appeal to some other authority. It was a position which was simmering, and it would find an outlet by and by. The Committee had made no preparations; they were hoping for a change for the better.

By a large majority—the opposition being chiefly Labour—the Leeds City Council, on Wednesday last week, agreed to the advance of the salary of Mr. J. B. HAMILTON, tramways manager, from £1,000 to £1,500 per year, irrespective of his salary of £500 per year as the Corporation's commercial manager.

Maidstone T.C. has increased the salary of the electrical engineer, Mr. HOADLEY, from £618 per annum to £769 as from April 1st, and from that date £1 for every extra 35 KW. on maximum demand, £1 for every additional 35 consumers, and £1 for every additional 100,000 units sold.

Mr. J. A. CRESSEY, who was recently demobilised, has been appointed shift engineer at the Peterborough municipal electricity works, and has taken up his duties. He was formerly charge engineer at St. Albans electricity works, from which he enlisted with the R.E. in June,, 1915, serving in France during the winter of 1916.

Mr. ANNETTS, late electrical engineer to the Morecambe T.C., who is proceeding to Oxford, has been presented with a cup by the electricity works staff.

Exeter T.C. is recommended to increase the salary of the electrical engineer to £750 a year.

Mr. E. S. TAYNER, borough electrical and tramways engineer, Doncaster, has been granted an increase of salary from £550 to £700 for one year, and after that to £750. Mr. Rayner has had an increase of £100 since his return from temporary Government war service.

At last week's meeting of the Swansea Corporation Electricity Committee, the Town Clerk read a communication from the Ministry of Labour asking consideration of an application by the Associated Municipal Electrical Engineers to grant chief electrical engineers and managers of electrical undertakings the awards made to the engineering and foundry trades by the Committee on Production, and also to adopt a formula based on the size of the stations, number of units generated, &c., which, the Town Clerk explained, meant in the case of the borough electrical engineer, Mr. J. W. BURR, a total increase in salary from £700 to £1,050 per annum, the increase, according to the Society's application, to be retrospective to March, 1918. The Ministry of Labour, who had been approached in the matter, suggested that, failing an amicable arrangement, the matter be referred to arbitration. —The Chairman referred to a resolution of the Council to defer all increases in salary to the chief officials of the Corporation for 12 months, and asked what was the Committee's position.—The Town Clerk said that that resolution could be rescinded at any time.—Several members admitted they would have to "face the music," and Mr. Morgan Rees thought it the better plan to reconsider the question of the whole of the chief officials' salaries.—Mr. Daniel Jones moved that the salary of the electrical engineer be increased to £1,050. It was better to make a clean cut of it.—The Town Clerk said that several municipalities had given the increases asked for.—Mr. Dd. Richards proposed an amendment that the matter be referred to arbitration.—The amendment was lost and the resolution adopted.

The Stafford Town Council has increased the salary of the electrical engineer, Mr. ROBINS, from £388 per annum to £550, the present emolument of house, light, fuel, &c., to be continued.

Mr. C. A. HOPKINS, of the Chatham & District Light Railways Co., and formerly of the Swindon Corporation electricity and tramway department, has been appointed chief clerk to the Wigan Corporation tramways.

General.—Last week the Duke of Connaught, as President of the Royal Society of Arts, presented to Sir OLIVER LODGE the Albert Medal of the Society in recognition of his work as the pioneer of wireless telegraphy.

Mr. LIONEL ROBINSON and Mr. JAS. DEVONSHIRE have been elected directors of the Underground Electric Railways Co. of London.

Captain J. E. BANNEN, R.A.M.C., has been appointed specialist in electrical science, Poona Division, with effect from April 15th, vice Captain Goss, R.A.M.C., vacated.—*Indian Engineering.*

Mr. JOHN NEWLANDS, who has retired, is, according to the *Daily Chronicle*, to be succeeded in the controllership of the Central Telegraph Office by Mr. John Lee, postmaster of Belfast; and the deputy-controller, Mr. John Bailey, who has also retired, is succeeded by Mr. A. W. Edwards.

Mr. J. DIGBY, who was connected with the Marconi Co. for 10 years, and for five years held the speed record for long-distance wireless, and has been an instructor in Marconi Schools in London, Glasgow, and Manchester, will be principal in the Northern Wireless College, which is to be opened shortly in Belfast.

The King has conferred the Territorial Decoration on Capt. and Temp. Lieut.-Col. H. E. WEBB-BOWEN, D.S.O., Major A. LEVIN, and Capt. G. W. C. KAYE, London Electrical Engineers, and on Major G. A. BRUCE, Tyne Electrical Engineers.

Lieut. E. W. YOUNG, Kent Fortress Engineers (Electric Lights Companies), has been restored to the establishment to which he was a supernumerary. He was commissioned in 1915, and served for a considerable period with a regular unit of the Royal Engineers.

Lieut. W. A. GLADWIN, Tyne Electrical Engineers, has been restored to the establishment of the Corps. He was commissioned in October, 1916, was at the School of Instruction for some time, and seconded in his Corps whilst there.

Quartermaster and Lieut. A. KENNEDY, Royal Engineers (Electrical), Territorial Force, has been promoted captain. Capt. Kennedy received his commission in the London Electrical Engineers as Quartermaster and Lieutenant in May, 1916.

Mr. FREDERICK M. WEST has relinquished his commission as second-lieutenant, R.G.A., on account of ill-health, retaining his rank, after being invalided home from France. Mr. West

is anxious to resume touch, after four years' service with the Forces, with his many electrical friends. Mr. West will be remembered by our readers as the contributor of a series of articles on "The Selling Side of Electricity." He has resigned his position with the St. Marylebone electricity supply undertaking in order to join the A. & A. Electrical Co., Ltd., of 13, Farringdon Road, E.C., as manager of their factoring department.

Birthday Honours.—The honour of Knight Grand Cross is conferred upon Sir H. LLEWELLYN SMITH, K.C.B., Secretary to the Board of Trade. G. E. P. MURRAY, Esq., C.B., Secretary to the G.P.O., is made a Knight Commander.

Capt. B. F. MCMURTRIE, manager of the export department of the British Thomson-Houston Co., Ltd., who saw two years' active service in France and 15 months in Italy, has been included in the King's Birthday Honours for the O.B.E. (Military Division).

Lieut. A. MCDOUGALL, R.E., whose name appeared in the Birthday Honours List as receiving the M.B.E. (Mil. Div.), was before the war employed in the electrical department of the N.E. Rly. at the C.M.E.'s Office, Darlington. He is an Associate of both the Electrical and Mechanical Institutions. Lieut. McDougall joined the Forces in January, 1915, and for the first one and a half years was engaged in mine laying. He was commissioned in the R.E., and has been responsible for the erection and maintenance of several small generating stations for the searchlights in connection with anti-aircraft work. He is at present retained as Technical Adviser for that work in the Dundee area.

Among those who received honours in connection with the King's birthday is Major HARRY RICHARDSON, the general manager and engineer of the Dundee Corporation electricity department, who has been awarded the O.B.E.

Obituary.—MR. P. S. BEASLEY.—The staff and employés of Messrs. Willans & Robinson, Ltd., of Rugby, have placed in the cemetery an Aberdeen granite cross over the grave of the late Mr. P. S. Beasley, assistant works manager, who died on October 16th last.

NEW COMPANIES REGISTERED.

F. Smith & Son (Southampton), Ltd. (155,622).—Public company. Registered May 30th. Capital £25,000 in £1 shares. To take over the business of a marine optician and compass adjuster carried on by J. Crombie Smith & Son, at 23, Oxford Street, Southampton, and also the business of electricians, electrical engineers and fittings makers carried on by E. M. F. (1914), Ltd., at London and Walsall. The first directors are: John Crombie Smith, 23, Oxford Street, Southampton, marine optician; Joseph Max Bein, 56, Belmont Road, Portswood, Southampton, electrical engineer; and William Steel, 37, Cromwell Road, Southampton, marine optician. Solicitor: J. D. Bassitt, 154, Above Bar, Southampton. Registered office: 23, Oxford Street, Southampton.

Ratherham & Co., Ltd. (155,711).—Private company. Registered June 3rd. Capital £1,000 in £1 shares. Manufacturing, mechanical, and electrical engineers, toolmakers, and manufacturers of clipping machines, particularly horse clippers and toilet clippers, &c. The subscribers are: J. Ratherham, 27, Church Road, Hanwell, engineer (300); A. Cutts, 325, Franklin Road, King's Norton, Worcs., engineer (100); E. Carwardine, 34, Drayton Road, Edgbaston, Birmingham, secretary (100). First directors: J. Ratherham, A. Cutts, and E. Carwardine. Registered office: St. Dunstan's Works, St. Dunstan's Road, Hanwell.

Rapid Accumulator Co., Ltd. (155,710).—Private company. Registered June 2nd. Capital £25,000 in £1 shares. To acquire patents relating to the production, treatment, storage, application, distribution, and use of electricity. The subscribers (each with one share) are: F. C. Hilbery, 4, South Square, Gray's Inn, W.C.1, solicitor; F. Smith, 4, South Square, Gray's Inn, W.C.1, clerk. Permanent directors: J. W. Johnstone, 46, Leadenhall Street, E.C.; J. Cartier, 110, Cannon Street, E.C.; A. Andries, 1, West Terrace, Folkestone. Registered office: 110, Cannon Street, E.C.

Indicators, Ltd. (155,585).—Private company. Registered May 29th. Capital £24,000 in 22,500 7 per cent. participating preferred shares of £1 each and 30,000 ordinary shares of 1s. each. To acquire patents relating to advertising by electricity, and to any apparatus therefor, from P. H. Waller and B. E. Nordman. The subscribers (each with one preference share) are: P. H. Waller, 41, Wilson Road, Camberwell, S.E.5, engineer; B. E. Nordman, 25, Ashford Avenue, Hornsey, N.8, merchant; T. J. Garstang, 36, Priory Avenue, Hornsey, N.8, poor law official. Directors: P. H. Waller, B. E. Nordman and T. J. Garstang. Solicitors: Russell and Arnholz, 3 and 4, Great Winchester Street, E.C.2.

Webster, Mitchell, Ltd. (155,647).—Private company. Registered May 30th. Capital £5,000 in £1 shares. Merchants, manufacturers' agents, general agents, &c. The subscribers (each with one share) are: F. E. Hayward, 45, Finsbury Pavement, E.C., incorporated accountant; E. Clough, 22, Brigstock Road, Thornton Heath, engineer. First directors: H. J. Mitchell, managing director of Hedley Mitchell, Ltd., drapers, Erith; A. V. Downton, director of Enfield Electrical Cable Co., Ltd., Brimsdown, Middlesex; and A. W. Webster, 46, Hafton Road, Catford, S.E. Registered office: 52, Cheapside, E.C.

Moulson & Anderson, Ltd. (155,704).—Private company. Registered June 2nd. Capital £5,000 in £1 shares. To enter into agreements with A. E. Moulson and G. E. Anderson and to carry on the business of general electrical and mechanical engineers. The subscribers (each with one share) are: W. Holroyd, 3, Silverhill Drive, Bradford, sheet metal engineer; A. E. Moulson, 70, Cumberland Road, Bradford, engineer; G. E. Anderson, 45, Woodhall Road, Bradford, engineer. The first directors are: W. Holroyd, A. E. Moulson, and G. E. Anderson. Registered office: Ross Works, Birkstand Street, Bradford.

Manchester Armature Repair Co., Ltd. (155,702).—Private company. Registered June 2nd. Capital £15,000 in £1 shares (5,000 preferred). To acquire the business carried on at Ford Lane, Pendleton, as the Manchester Armature Repair Co., to enter into an agreement with C. H. Wilson and others, and to carry on the business of electricians, engineers, manufacturers and repairers of electrical apparatus and appliances, &c. The subscribers (each with one share) are: C. H. Wilson, Glen View, Saltburn-by-the-Sea, chemical manufacturer; A. B. Hutton Wilson, Eggliscliffe, County Durham, chemical manufacturer; R. Ainsworth, 15, Half Edge Lane, Eccles, Manchester, electrical engineer. The first directors are: C. H. Wilson, A. E. Hutton Davies, and R. Ainsworth. Solicitor: P. H. Monk, 13, Queen's Terrace, Middlesbrough.

Ernest Wainwright (London), Ltd. (155,661).—Private company. Registered May 31st. Capital £5,000 in £1 shares. To acquire the business of an electrical engineer, manufacturer, and merchant of engineering appliances, electrical fittings and gramophone motor parts, carried on by E. Wainwright at 159, Victoria Street, Westminster. The subscribers (each with one share) are: E. Wainwright, 44, Montalt Road, Woodford Green, merchant; S. W. J. Vaisey, 15, Rowan Road, Hammersmith. Directors: E. Wainwright and S. W. J. Vaisey. Registered office: 159, Victoria Street, S.W.1.

Signal Electric Co., Ltd. (155,685).—Private company. Registered May 31st. Capital £12,500 in 10,000 7 per cent. preference shares of £1 each and 5,000 ordinary shares of 10s. each. To manufacture electrical accessories and appliances of all kinds, &c. The subscribers (each with one preference share) are: E. Baker, 22, Tottenham Court Road, S.W., cinema proprietor; E. St. John, 48, Batoum Gardens, Hammersmith, W. First directors to be appointed by the subscribers. Solicitor: P. Holt, 4, Bank Buildings, Purley.

CITY NOTES.

Altrincham Electric Supply, Ltd.

During 1918 24 new installations were connected. Actual consumers number 1,785. After meeting debenture interest premium on debenture redemption policy, &c., the profit is £7,130, plus £431 brought forward. After meeting preference dividend to September, 1918, amounting to £2,555, putting £600 to reserve for income tax, and £500 to reserve for depreciation of plant, &c., 9s. per share is to be paid on the deferred shares, absorbing £3,150 out of the balance of £3,906. The results fall short of the anticipated figures owing to increased cost of fuel and restricted consumption, also reduction of power consumption for industry after the signing of the armistice. The Broadheath district is coming largely into favour as a manufacturing centre, and fresh applications for power are being received; still further works are to be erected. At the generating station two water-tube boilers and a 2,000-KW. turbo-generator are to be added, which, together with additional mains, &c., will cost £40,000. In order to provide this the capital of the company is to be increased to £100,000 by the issue of 50,000 shares of £1 each. The new plant will enable the present Lancashire boilers to be dispensed with; fuel economy and increased efficiency will result.

Richardsons, Westgarth and Co., Ltd.

At the annual meeting, held at Hartlepool, on June 3rd, Mr. D. B. Morison, the chairman, stated that during the war period the total H.P. of the engines manufactured by the company was 603,000, 503,000 being for ships and 100,000 for the generation by steam turbo plants of electric power on land. In addition, a 25,000-H.P. rolling-mill engine and considerable steel works plant had been supplied. With the further payment of arrears now proposed there would, within a period of nine months, have been paid to preference shareholders four years' dividend, or 24 per cent. A greater distribution of profits could not be made in consequence of the taxation demands of the Government. Of every £1,000 earned above the firm's extremely low pre-war standard, there was, after the deduction of profits tax and income tax, only left to the company £140—a mere remnant. The acute desire of the taxing authorities to get money from any available source should be tempered with an adequate appreciation of the efforts which were put forth by manufacturers during the war, and of the equally strenuous exertions which must still continuously be made if we were to win out in the industrial world competition—competition that was bound in the future to be infinitely keener than ever before. Permission to extend the firm's boiler works at Middlesbrough was refused by the Government, and as a consequence the company had now to face a very heavy expenditure in order to meet the requirements of their business.

German Companies.

The directors of the *Akkumulatoren Fabrik A.G., of Berlin*, recommend a dividend at the rate of 20 per cent. for 1918.

The Korting und Mathiesen A.G., of Leutzsch, makers of electrical apparatus, intend to distribute 15 per cent. for 1918, being the same rate as in the previous year.

The Elektrizitats Gesellschaft vorm. W. Lahmeyer & Co., of Frankfort-on-Main, reports net profits of £142,000 for 1918, as contrasted with £134,000 in the previous year. It is proposed to distribute 8 per cent., being the same rate as for 1917.

The Welter Elektrizitats und Hebewerkzeuge A.G., of Cologne-Zollstock, reports net profits of £1,700 for 1918, as contrasted with £5,100 in the previous year. It is intended to pay a dividend of 8 per cent., as in 1917.

The Elektrizitats Lieferungs Gesellschaft, of Berlin, which owns or is otherwise interested in a number of supply works, reports net profits of £163,700 for 1918, as compared with £163,500 in the previous year. A dividend of 10 per cent., as in 1917, is in contemplation.

The accounts of the *Kabelwerk Wilhelminenhof A.G., of Berlin*, whose share capital of £50,000 is held by the Felten and Guilleaume Co., show net profits of £12,000 for 1918, or the same as in the preceding year, when a dividend at the rate of 20 per cent. was paid. The method of disposing of the profits for last year is not disclosed.

The Sachsenwerk, Licht und Kraft A.G., of Niedersedlitz, which has a share capital of £375,000, intends to pay a dividend at the rate of 20 per cent. for 1918, as against 30 per

cent. in the previous year. It is stated that instead of being paid in cash the dividend is to be distributed "by request" in the form of new shares upon which shareholders will be required to contribute an additional sum of £4 per share.

The Treuhand Bank fur die Elektrische Industrie, of Berlin, which is closely associated with the A.E.G., Lahmeyer group, earned profits of £38,000 in 1918, as against £46,000 in 1917, apart from the balance of £5,000 brought forward. After defraying general expenses and taxes it has been necessary to write off £97,000 for losses on exchange, and the year closes with a deficit of £56,000 on a capital of £500,000. This result compares with a dividend of 4¼ per cent. in 1917.

The report of *Hartmann und Braun A.G., of Frankfort-on-Main*, records a decline in the net results in 1918 owing to higher wages and general expenses, and to losses through demobilisation. After writing off £21,000 for depreciation, as compared with £30,000 in 1917, the accounts indicate net profits of £17,000, as against £51,000 in the previous year. The dividend is at the rate of 9 per cent., and compares with 15 per cent. in 1917, 14 per cent. in 1916, and 12 per cent. in 1915. The directors state that the company has been working at a loss since the beginning of 1919, and it is a question whether it will be possible to retain much longer the present number of workmen who are in excess of those employed in peace times.

The report of *Felten und Guilleaume Carlswerk A.G., of Cologne-Mulheim*, states that the maximum output of the works was reached at the end of 1917, and continued until the autumn of 1918. Owing, however, to the greatly increased working expenses the profits experienced a material decrease which was aggravated by the disproportion between the number of workmen employed and the orders on hand at the end of 1918. After appropriating £185,000 for depreciation, as compared with £243,000 in 1917, the accounts represent net profits of £338,000, as against £519,000. A dividend at the rate of 10 per cent. is recommended on the ordinary share capital of £3,000,000, this result contrasting with 15, 12, 11, 8, and 8 per cent. in the five preceding years respectively.

The directors of the *Bergmann Elektrizitats Werke A.G., of Berlin*, reporting on the past year, state that a further increase in the deliveries took place, peace manufactures rising from 50 to 60 per cent. of the total turnover. An installation at 100,000 volts for the Murg works of the Baden Government had proved to be satisfactory, and further and similar plants were in course of execution. A high-speed locomotive built by the company had been in regular service for some time past, and 14 similar locomotives were being completed. The introduction of the 8-hours day and the considerable increases in wages would have such a material influence on the costs of production that serious attention should be paid to the question of competitive capability, especially in the export trade. As extra depreciation was no longer necessary the amount written off has declined from £253,000 in 1917 to £198,000 last year, whilst the net profits have risen from £373,000 to £635,000 in the two years respectively. The directors recommend the payment of a dividend of 12 per cent., being the same rate as in 1917 and comparing with 10 per cent. each in 1915 and 1916, and 5 per cent. in 1914.

Great Northern Telegraph Co.—The directors of Det Store Nordiske Telegraf Selskab, of Copenhagen, at the annual meeting to be held on July 18th, will recommend the payment of a dividend at the rate of 22 per cent. for 1918, this percentage including the 5 per cent. interim payment already made. The sum of 800,000 kr. has been placed to the reserve and renewal fund, 1,000,000 kr. to the cable steamers' renewal fund, 250,000 kr. to the pension fund, and 2,000,000 kr. set aside for extraordinary taxes, whilst 816,379 kr. has been carried forward. The directors have allocated 1,000,000 kr. as gratuities to the staff in connection with the fiftieth anniversary of the formation of the company, which fell on June 1st. In addition, they have presented a fund of 250,000 kr. to the Polytechnic Academy (Laereanstalt) in recognition of the fact that the company's existence was due to H. C. Orsted's ingenious invention, the fund to be known as "H. C. Orsted's Fund for Technical Scientific Investigation and Associated Practical Objects."

Bell Telephone Co. of Canada.—The capital has been increased from $18,000,000 to $22,500,000. Existing holders have the right to subscribe for one new share of $100 for every four shares held.

United River Plate Telephone Co., Ltd.—Final dividend 5 per cent. on the ordinary shares, making 8 per cent. for the year, free of tax. Carried forward £36,707.

Yorkshire (West Riding) Electric Tramways Co., Ltd.—Interim dividend 3 per cent. for the half-year on the 6 per cent. cum. pref. shares.

Shawinigan Water & Power Co.—Quarterly dividend 1¼ per cent.

Browett, Lindley & Co., Ltd.—Net profit for 1918, £11,478. After paying the full 6 per cent. on the pref. shares for 1918, and a further 6 per cent. in payment of arrears thereon, both less tax, 8 per cent., less tax, is paid for the year on the ordinary shares. All Government contracts were cancelled in January, and work thereon ceased on February 28th. Since then satisfactory progress has been made in changing over from w[illegible]duction to ordinary commercial business.

Kalgoorlie Electric Power & Lighting Corpn., Ltd.—The directors' report states that the result of operations during 1918 again shows a falling off in profit. The chief factor in this result was the falling off in revenue due to decrease in the power sales. There has been a steady decrease in the amount of current taken by large consumers which the new business obtained is too small to counterbalance. The directors hope that when Peace has at last been signed a more normal condition of affairs will soon prevail on the Kalgoorlie goldfield, and that with a more plentiful supply of labour there will be a larger demand for electric current.

During the year £7,525 was paid off the debenture debt, which has been reduced from £61,200 in December, 1917, to £22,475, as which it stands today. The cash for this reduction has been obtained from revenue; no new capital debt has been incurred. The money required for this service last year was £9,625, and the amount required for the current year is £9,073; this will pay the interest and reduce the debt to £14,975.

The profit for 1918 was £10,622, as against £15,910 for 1917. This large decrease is a matter of anxiety to the Board, particularly because it is largely the unavoidable result of the conditions prevailing on the goldfield. There is now hope of some improvement in these conditions.

The company's property has been maintained in good condition, and the plant and machinery in thorough working order. The cost of repairs and renewals have been unusually heavy during the past year. The cost of operating was also increased for some months by the breakdown of one of the most efficient units of generating plant; this has been repaired, and is again in operation.

Madras Electric Supply Corporation, Ltd.—Mr. James Gray, presiding at the meeting held in London on June 4th, said that the improvement was satisfactory considering the restrictions regarding supplies of materials, and other handicaps. The total revenue was £66,112, against £59,057, while the expenditure was £29,546, against £26,532. The total cost of production was 1.16d. per unit, and the revenue 2.48d., against 1.07d. and 2.35d. in 1917. The cost of production always would be relatively high because of the high price of coal in Madras and the scattered nature of their area. They had reason to believe that their application for power to increase the charge for current for lighting and fans from As.4 to As.5 would be granted. A further revision might be considered at the end of three years instead of five under the Indian Electricity Act. This period would enable them to put the undertaking into a sound financial position and to show such a return on the ordinary shares as to attract fresh capital at reasonable terms for extensions. There was ample scope for extension, and the speaker did not see why the company should not continue to show good results.

Danish Accumulator Works.—According to advices from Copenhagen, the annual meeting of the A.S. Akkumulator Fabriken was held in that city at the end of May. Mr. M. Lassius, the chairman, stated that the company's activity in 1918 bore the impress of the difficult circumstances of the times. Not the least had the situation in Germany, whence the company had to procure a large quantity of materials, contributed towards hindering the carrying on of intense activity. The first half of 1918 for these reasons was unfavourable, but the position in 1919 had considerably improved. During the year the company acquired a site in Buddinge, where it was intended to erect a factory, which would presumably be in full operation at the beginning of 1920. The accounts submitted showed net profits of 34,505 kr., which sum has permitted of the payment of a dividend at the rate of 7 per cent.

Stock Exchange Notice.—The Committee has been asked to allow the following to be quoted in the Official List:—

Electric Construction Co., Ltd.—75,800 ordinary shares of £1 each, fully-paid.

Siemens Bros. & Co., Ltd.—120,000 shares of £5 each, fully-paid, Nos. 1 to 120,000; 80,000 shares of £5 each, fully-paid, Nos. 120,001 to 200,000, and £500,000 4¼ per cent. debenture stock.

Tramways (M.E.T.) Omnibus Co., Ltd.—100,000 7 per cent. cumulative preference shares of £1 each.

Merthyr Electric Traction & Lighting Co., Ltd.—The revenue for 1918 was £32,798, against £28,978 for 1917. After meeting expenses, debenture charges, putting £3,000 to renewals and £2,000 to deferred maintenance, 6 per cent. is paid on the ordinary shares and £212 carried forward. The gross revenue of the electricity supply system was £14,179, against £13,084. Units sold for lighting and power 827,739, against 695,568. The light railways revenue increased by £2,746 to £18,547.

Birmingham District Power & Traction Co., Ltd.—For 1918 net revenue from tramways and from dividends and interest upon investments was £96,572. After deducting administration and general expenses, &c., surplus remains of £79,185, making, with £6,190 brought forward, available total of £85,375. Deducting debenture interest, debenture sinking fund, £7,854; provision for renewals, £14,527; dividend on cumulative participating preference, there remains £35,003. Directors recommend placing to reserve £6,297. Dividend on ordinary at rate of 6 per cent. for year; forward, £6,030.—*Financier*.

Tramways (M.E.T.) Omnibus Co., Ltd.—After meeting debenture and loan interest, putting £6,378 to debenture redemption fund, and writing £4,385 off preliminary expenditure, the profit is £35,028. A dividend of 2s. per share (against 4s. for 1917) is declared, £15,000 is put to reserve, and £1,056 is to be carried forward.

Shanghai Electric Construction Co., Ltd.—Sir Alfred Dent presided at the annual meeting on 5th inst., and said that, deducting working expenses in Shangai, there was an operating profit of £51,822. The profit on exchange was £22,878, an increase of £5,026. The reserve for renewals had been increased by £9,520 to £73,690. They would have heavy charges against this reserve in future, and as the cost of renewals would be higher they might have to make larger annual appropriations to that account. The chairman referred to the valuable services of the Shanghai staff, the local board, and Mr. McColl, the general manager.

Calcutta Tramways Co., Ltd.—Revenue for year 1918 £135,270, plus £8,434 brought forward, making £143,704. Final dividend 6s. per share, making 8¼ per cent. for the year (against 8 per cent. for 1917), free of tax; to reserve for depreciation, &c., £25,000; to reserve for depreciation of investments, £2,000; contribution to staff provident fund, £1,331; balance forward, subject to English excess profits duty and Indian super tax, £28,639.

Swansea Improvements & Tramroads Co.—The revenue increased by £13,657 in 1918, to £93,411. Expenses increased by £14,164 to £80,453. After putting £6,000 to renewals, £2,000 to deferred maintenance, £3,000 to reserve, and paying 6 per cent. for the year on the ordinary shares, £2,214 is to be carried forward.

British Electric Traction Co., Ltd.—After putting £20,000 to reserve it is proposed to pay 6 per cent. on the cumulative participating preference stock and 3 per cent. on the ordinary stock.

National Electric Supply Co., Ltd.—Interim dividend of 2s. 6d. per share, less tax, on the ordinary shares for the half-year.

STOCKS AND SHARES.

TUESDAY EVENING.

THE terms of the Consolidation Loan will be out before we are, so it would be rather superfluous to give estimates current as we write on the day after the Bank Holiday. Nevertheless, these estimates are for the moment exercising considerable influence over prices, and the gilt-edged markets are in a divided frame of mind. Business naturally suffers by the so-near approach of the long-expected, and anticipation stands a-tiptoe to see whether the new Loan will be on such terms as to render it an active, immediate competitor with existing securities.

The holiday had some little effect in checking the stream of new issues, but only to a minor extent, and those which have appeared lately can claim that, on the whole, they have received substantial support. One financial feature of the present year is undoubtedly the rush for any new issues that have promised reasonable security and good return.

The market in electricity supply shares is so quiet as to be almost dormant. No changes in prices have taken place this week. Until more definite information is forthcoming of the Government's intentions, the share market is bound to continue quiescent. Hope has been raised of the Government scheme providing for extension of the London companies' tenure, and, while it may not be safe to build too much upon this ground, it deserves consideration, and proprietors of the shares would doubtless give it hearty support. Fifteen or more years ago the question was debated in these columns as to the basis upon which the undertakings would be taken over in 1931 and thereabouts, but nobody could say for certain, and the time now grows comparatively near when the original concessions will expire. Various authorities have quite made up their minds what the basis will be, but as the opinions differ, the plain investor has shrugged his shoulders and has sometimes said frankly that he preferred shares not tinged with the elements of uncertainty which surround electric lighting issues. Were this handicap to be removed, the share market would certainly pass on to another plane. The Government has issued a memorandum showing that the suggested payment of twenty million sterling, on urgent electrical works, will be spread over the next five financial years.

Although progress in Mexico has once more been impeded by a revolutionary outbreak, speculation begins to concern itself with the question of back interest due upon the bonds of the various Mexican Utility companies. The last coupon paid upon the 5 per cent. first mortgage bonds of the Mexican Electric Light Corporation was that of July, 1914. The Mexican Light & Power and the Mexico Tramways are both in arrears on their bonds, firsts and seconds alike, since the autumn of 1914. In other words, there is about 45 per cent. interest unpaid on the various bond issues, and the matter will have to be dealt with sooner or later. It seems far too sanguine to suppose that this debt will be cleared off by cash payments. The Mexico Tramways Co. has been handed back, we believe, the ownership of its property which had been in the hands of the Mexican "Government" for nearly five years. How much money will be required to put the utility undertakings into good order is an unknown quantity, but that there will have to be a general overhauling, physical and financial, is only too probable, and the process may involve reorganisation on lines with which British holders of American Railroad securities were, in days gone by, unpleasantly familiar.

Active dealings in Marconi shares have had a stimulating effect upon the price, which advanced to 6½ before easing off to 6 5/16. The buyers are on the look-out for a juicy plum as the result of the company's case before the Courts, and the recent evidence led to revival of confident optimism. Manifestly the shares are for the moment something of a gambling counter, and it will be a good thing when the case is settled finally, and the shares rank as industrial investments ex plum possibilities.

Western Telegraphs lost ¼ at 17½, otherwise the share list of cable issues is as featureless as that of electricity supply shares. The manufacturing group is also quiet. British Westinghouse preference have come into strong demand, the price being 5s. higher at 2 13/16. Railway markets are listless and apathetic. Underground incomes are up ½, but the £10 shares can be bought at 3½, and Metropolitan Consolidated is ¼ lower. In the foreign division, Brazilian Tractions slipped back to 61 after being higher, and the preferred at 92 are also a point down. Canadian electrical issues have hardened in consequence of the strike outlook being less depressing. Anglo-Argentine Trams continue to give way, still on the labour situation. British Columbia Electric Railway stocks hold their improvements.

The chemical group is still dull, and rubber shares are very heavy. The immediate prospect for rubber is closely connected with the raising of the blockade with Germany, and the chance of the enemy declining to sign Peace terms at once is deemed a bear point for the rubber industry.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1917.	Dividend 1918.	Price June 10, 1919.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES					
Brompton Ordinary	10	8	6½	—	£5 8 10
Charing Cross Ordinary	4	4	3½	—	6 8 1
do. do. do. 4½ Pref.	4½	4½	3½	—	6 18 4
Chelsea	5	5	3½	—	4 2 9
City of London	8	8	11½	—	6 14 6
do. do. 6 per cent. Pref.	6	6	10	—	6 0 0
County of London	7	7	10½	—	6 18 8
do. do. 6 per cent. Pref.	6	6	10	—	6 0 0
Kensington Ordinary	7	6	5½	—	5 4
London Electric	Nil	Nil	1½	—	Nil
do. do. 6 per cent. Pref.	6	6	8½	—	7 14 10
Metropolitan	4	6	8½	—	8 0 0
do. 4½ per cent. Pref.	4½	4½	8½	—	6 18 6
St. James' and Pall Mall	9	10	7½	—	7 0 4
South London	5	5	2½	—	7 5 6
South Metropolitan Pref.	7	7	20/6	—	6 16 7
Westminster Ordinary	9	8	6½	—	6 10 8
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	100	—	6 0 0
do. Def.	1½	33/6	22½	—	7 8 0
Chile Telephone	8	8	7	—	5 14 4
Cuba Sub. Ord.	7	7	11	—	*6 4 5
Eastern Extension	8	8	16½	—	*4 17 9
Eastern Tel. Ord.	8	8	166½	—	*4 16 1
Globe Tel. and T. Ord.	7	8	16½	—	*4 19 3
do. do. Pref.	6	6	10½	—	5 13 0
Great Northern Tel.	22	22	89	—	6 17 6
Indo-European	13	13	55	—	5 18 2
Marconi	20	20	6⅜	+1/16	3 3 6
Oriental Telephone Ord.	10	15	9½	—	6 6 4
United R. Plate Tel.	8	8	9⅛	—	*4 17 9
West India and Panama	1/3	1/3	1⅛	—	*4 6 4
Western Telegraph	8	8	17½	—¼	*4 13 5
HOME RAILS.					
Central London Ord. Assented	4	4	83½	—	6 6 0
Metropolitan	1	1½	26	—½	4 16 4
do. District	Nil	Nil	24½	—	Nil
Underground Electric Ordinary	Nil	Nil	8½	—	Nil
do. do. "A"	Nil	Nil	10/9	—	Nil
do. do. Income	4	5	90	+½	*5 4 2
FOREIGN TRAMS, &c.					
Adelaide Snn. 6 per cent. Pref.	6	6	48	—	6 11 4
Anglo-Arg. Trams. First Pref.	6½	Nil	3½	—½	—
do. do. 2nd Pref.	—	—	3½	—	—
do. do. 5 Deb.	5	5	62½	—	7 8 5
Brazil Tractions	—	—	61	—½	—
Bombay Electric Pref.	6	6	113	—	5 11 7
British Columbia Elec. Rly. Pfce.	5	5	60½	—	7 17 6
do. do. Preferred	Nil	2½	48½	+1	5 3 1
do. do. Deferred	Nil	Nil	44½	+1	Nil
do. do. Deb.	4½	4½	62	—	6 17 4
Mexico Trams 5 per cent. Bonds	Nil	Nil	62½	—1	Nil
do. 6 per cent. Bonds	Nil	Nil	51½	—1	Nil
Mexican Light Common	Nil	Nil	37	—	Nil
do. Pref.	Nil	Nil	51	—	Nil
do. 1st Bonds	Nil	Nil	69	—1	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	15	4	—	3 15 0
British Aluminium Ord.	10	10	1½	—	5 18 6
British Insulated Ord.	25	12½	2½	—	5 11 1
British Westinghouse Pref.	7½	8	2⅞	+⅛	5 14 0
Callenders	25	25	10½	—	6 3 0
do. 6½ Pref.	5	6½	3⅜	—	6 3 10
Castner-Kellner	25	20	3	—	6 13 4
Edison-Swan, "A"	—	—	1⅝	—	6 17 0
do. do. 5 per cent. Deb.	4	5	75½	—	6 12 3
Electric Construction	10	10	1⅜	—	7 16 0
Gen. Elec. Pref.	6	6½	10½	—	6 3 10
do. Ord.	10	10	21½	—	*4 13 0
Henley	25	25	2⅞	—	8 3 6
do. 4½ Pref.	4½	4½	3½	—	6 0 0
India-Rubber	10	10	17½	—	*5 13 6
Siemens Ord.	—	10	6½	—	*7 4 0
Telegraph Con	20	20	26½	—	4 13 6

*Dividends paid free of Income Tax.

REGENERATIVE DIRECT-CURRENT ELECTRIC RAILWAYS.

By E. AUSTIN.

Perhaps nothing in the way of railway electrification is of greater interest or of greater importance at the present time than what is being done in certain quarters in the direction of applying the regenerative principle to electric trains. As far as three-phase railways are concerned, this is not, of course, by any means a new development, for the ease with which three-phase motors can be made to act as generators renders the polyphase system more amenable to regenerative braking than any other system, and on the Italian State railways and the Great Northern Railroad in America, where heavy trains ascend and descend steep gradients, very material benefits accrue from the use of regenerative equipments. The wear on brake shoes and wheels is considerably reduced, trains are controlled with ease and safety, a higher average speed can be maintained when trains are descending gradients, whilst the power saved as the result of current being returned to the line amounts to 15 per cent. or more of the total power consumption. On the other hand, the motors have to carry current for longer periods than they do under mechanical braking conditions, and if electric braking be adopted for stopping trains, especially suburban passenger trains, the increased motor heating becomes appreciable; much more so than is the case when regeneration is only resorted to whilst trains are descending gradients. Electric braking may, therefore, involve larger and heavier motors or increased ventilation. Further, there should always be a load on the line to absorb the regenerated current, otherwise the energy must be dissipated in resistances either on the trains or at the power house. But most of the disadvantages of regenerative electric braking are in many cases more than outweighed by the advantages. The increased weight of the equipments, for example, tends to increase the power consumption, but as this increase is much smaller than the power returned to the line, the extra weight does not constitute a real disadvantage, but merely reduces the advantages of electric braking by a small and often insignificant amount.

Whilst an induction motor readily acts as a generator when the speed of the rotor exceeds that of the revolving field, a simple series motor can only be made to regenerate by separately exciting the field windings. Any series motor will, of course, act as a series generator, but when it comes to making such motors return current to the line, difficulties immediately present themselves. It would be necessary in the first place to reverse the field winding of each motor and then to connect a resistance across the terminals so as to make the machines build up their voltage. Having attained a voltage slightly above the line voltage the machines might be directly connected to the line and made to provide the regenerated current, but in the event of the line voltage falling, as it is very liable to do on an electric railway, the regenerated current would immediately increase, resulting in turn in a stronger field and more current would flow into the system. This effect would be cumulative, until ultimately the circuit breaker would open. Conversely if the line pressure increased the regenerated current would be reduced, the motor fields would be weakened, and as this action is also cumulative the regenerated current would rapidly drop to zero. The field and back pressure of the motors being zero, heavy currents would then be built up in the opposite direction, currents much in excess of the most severe short-circuit currents, for it is to be remembered that when the polarity of the motors reverses they build up a voltage which is added to the line voltage. Reversal may take place so rapidly that excessive and dangerous currents may be established before circuit breaking arrangements have time to operate and serious flashing and other troubles may arise. The use of simple series motors without special exciting arrangements is therefore out of the question. Of course, as the field windings of a series motor consist of only a few low resistance turns they cannot be connected in shunt with the armature, even if the current be limited by resistances, for the energy dissipated in such resistances would represent a large proportion of that returned to the line. The object to be aimed at is to maintain the voltage of the motors (acting as generators) higher than that of the track by an amount sufficient only to overcome the resistance of the circuit involved. This is more difficult in the case of an electric railway than say in the case of a regenerative electric hoist, because in the latter case the voltage is as a rule relatively speaking constant and the resistance of the circuit is constant, whereas on an electric railway these quantities vary in an irregular manner, owing to the movement of the trains and other conditions peculiar to train operation. To devise means of limiting the regenerated current to a safe and suitable value under all conditions is one of the main difficulties to be grappled with when designing regenerative railway equipments. The regulating gear should not allow the motor exciting current to be increased in large and sudden increments, and preferably any such increment in the exciting current should be taken care of automatically. But sudden changes in the regenerated current are more liable to be set up as the result of variations in the line voltage, and the excitation of the motors must, therefore, vary with this voltage. The regenerated load should obviously be divided equally between all the motors, and sudden and large variations in the braking torque must be avoided. Another no less important point which must receive attention is the avoidance of the machines attaining an excessive pressure in the event of the supply being interrupted, for since railway motors acting as high-speed generators are not as a rule fully saturated, it is quite possible in the absence of proper precautions to obtain voltages much in excess of the normal voltage, and over voltage relays controlling the exciting circuit should therefore be provided.

One practical method of making a series motor regenerate, and one which has been tested with fairly satisfactory results, is to excite the field windings during the regenerative period with current derived from a low-voltage battery. The excitation in this case is, of course, constant, and if the line voltage drops the regenerated current is liable to become excessive, but the trouble may be overcome by a quick-acting controlling device actuated by the regenerated current, and introducing resistance into the field when the regenerated current becomes excessive. In practice this device, which takes the form of a current relay, is continually opening and closing, very much in the same way as the contacts of a Tirrill regulator. Owing to the flat speed characteristic of a system of this sort the braking controller must have a fair number of notches in order to avoid excessive changes in the regenerated current and braking torque when increasing the excitation, whilst precautions must also be taken to ensure that the braking effect does not diminish with increased speed, and before the motors can be connected to the line their voltage must be made approximately equal to the line voltage. The use of a battery, moreover, constitutes another disadvantage, and it is not surprising that this system has not established itself. Many other regenerative systems involving the use

of simple series motors have been proposed and tested, but no attempt will be made here to do anything more than to describe some of the most interesting and important. A regenerative system is shown in fig. 1, which has been found to possess the desired characteristics. The main motors A_1 and A_2 are in this particular case connected in parallel, and the motor generator M G with series field windings S T provides the requisite exciting current for the main motor fields during the regenerative period. These main motor fields are shown at F and F′ the generator G of the motor-generator set being connected in parallel with the fields by means of the

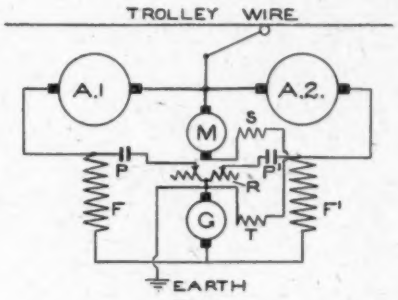


Fig. 1.

contactors P and P′. The sum of the regenerated current and the field current provided by the low-voltage generator G passes through a resistance R, and consequently if the line voltage drops, and so causes the regenerated current to be increased or an increase in this current is brought about by a change in the control conditions, then the voltage drop across the resistance R increases, and since the voltage of the small generator G is either constant or beginning to drop, as a result of the decreased line voltage, the voltage across the fields F and F (the

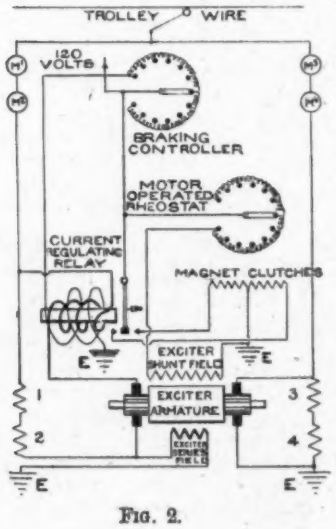


Fig. 2.

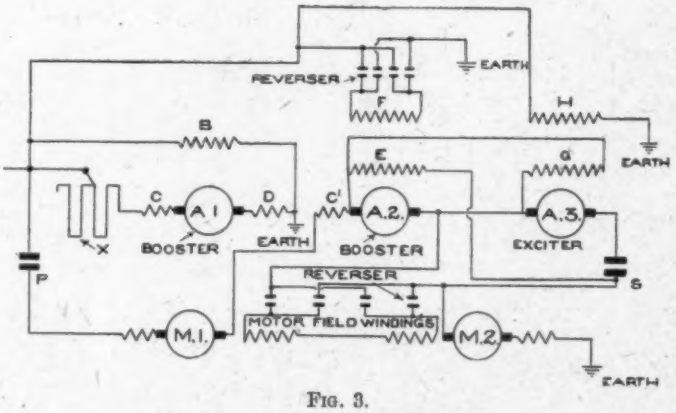


Fig. 3.

difference between the exciter voltage and resistance voltage) suddenly decreases, thus reducing the field strength of the main motors. By varying the value of the resistance x the speed and torque characteristics of the equipment can be changed at will without involving appreciable waste, the voltage across the resistance R being only a small percentage of the total line voltage. Tests have shown that if the motors, when acting as generators, are connected to the line with a voltage considerably in excess of the supply voltage, the regenerated current is immediately reduced to a permissible value, whilst the load is at all times equally divided between the motors. In the event of the supply failing, the regenerated voltage will naturally rise owing to the regenerated current in the resistance R being interrupted, and the resistance drop consequently diminishing. But a rapid cumulative rise in the motor pressure is nevertheless avoided by the inertia of the motor generator set, which takes a certain amount of time to increase its speed, whilst a damping effect of almost any desired amount may be secured by the use of damping windings on the poles of the small motor generator. It is an easy matter, therefore, to delay the voltage rise until the over-voltage relays have time to open, and so avoid the motors being subjected to excessive pressure. Of course, variations in the voltage applied to the field windings F and F′ due to variations in the drop in the resistance R are instantaneous, this being the special feature of the system. Since the small motor M driving the generator G is series wound it is apt to attain an excessive speed when running light, but this can be avoided by coupling it to the blower which provides the forced ventilation to one end of the motor-generator shaft. If the contactors P and P′ are opened, the main motors act as ordinary series machines, the armature G of the small motor generator set simply adding a few volts to the supply pressure. It is obviously possible, however, when the contactors P and P′ are closed to regulate the field strength during the motoring period, the only objection to this practice being that owing to the motor generator having to carry current for longer periods than when used for regeneration only, the machine must be made larger.

A simplified diagram of connections for the regenerative equipments used on the large direct current locomotives running on the Chicago, Milwaukee & St. Paul Railroad is shown in fig. 2. The main traction motors are shown at M_1, M_2, M_3, and M_4, and the main series field windings at 1, 2, 3, and 4. During the regenerative period the brushes at the opposite ends of the exciter armature, shown in the lower part of the diagram, are connected across the field windings, and it is evident the voltage across these field windings can be varied by varying the exciter voltage. This is accomplished by varying the exciter field current by means of the braking controller shown at the top of the diagram, but this controller is not directly connected to the shunt winding of the exciter. All the braking controller does is to alter the setting of a current-regulating relay, having an armature that moves against the action of a spring. This relay, shown on the left of the diagram, has two windings, a thick winding carrying the field and armature current of one pair of traction motors, and a shunt coil supplied with current at variable voltage obtained by adjusting the braking controller. Although the complete connections for this fine-wire coil are not shown in the diagram they will readily be understood, one pole

of the current source being connected to the braking-controller arm, and the other pole to earth. The spring-controlled relay armature controls by its movement one or the other of two magnetic clutches of a motor-operated rheostat which regulates the exciting current in the shunt winding of the exciter. The small motor which operates this controller runs continuously all the time regeneration is occurring, but the magnetic clutches determine in which direction the arm of the motor-operated rheostat turns, so that the exciter shunt current is increased or decreased according to which of the magnetic clutches is brought into operation by the relay. Normally the spring acting on the relay armature pulls the latter on to the contact that completes the circuit of the clutch, which causes the motor-operated rheostat to cut resistance out of the exciter field circuit. This, of course, causes the exciting current of the main traction motors to increase and more current flows round the series winding of the relay, and when this current becomes sufficiently great to produce enough flux to pull the relay armature away from the right-hand contact the motor-operated rheostat comes to rest. But if the regenerated current increases still further the relay armature is pulled over to the left-hand contact, which brings the other magnetic clutch into operation, and the motor-operated rheostat then inserts resistance in the exciter shunt field circuit. In this way the regenerated current supplied to the line is controlled.

The current in the shunt coil of the relay can be varied at will by the hand-operated braking controller, the flux due to this shunt coil being added to that due to the series coil so that the shunt coil flux assists in overcoming the spring tension acting on the relay armature. When the hand-operated braking controller is in its first position the current in the shunt coil is at its maximum, the result being that the relay acts with low currents in the series coil, but as the braking controller lever is moved from its first position the current in the relay shunt coil is reduced, and the relay setting increased, until ultimately the shunt coil is de-energised, and the operation of the relay is then, of course, entirely dependent upon the series coil. Further movement of the hand-operated braking controller reverses the shunt coil current, thus causing the flux due to this coil to oppose the series coil flux, and consequently a much heavier main current must flow in the series coil before the relay armature will "balance" or move over to the left-hand contact. The shunt coil current flowing in this reversed direction is then gradually increased until the same maximum current is obtained as was flowing when the controller arm was on the first notch, and this gives the maximum regenerative current permissible. For all ordinary variations in gradients, speed, and distances from sub-stations the action of the mechanism described is rapid enough to maintain a uniform braking effect, but when a locomotive is regenerating, and the trolley voltage is suddenly reduced, the motors may be called upon to carry more current than is good for them. This is prevented, however, by providing the exciter with a series winding which carries the line current and opposes the exciter shunt winding, and the demagnetising action of this coil prevents the regenerated current becoming excessive. Further, the exciter is driven by a series wound motor, which naturally varies its speed in accordance with the line pressure. Overload circuit breakers protect the motors in the event of the trolley wire being earthed, and high-voltage relays prevent excessive voltages being generated in the event of the main circuit being interrupted, as the result, for instance, of a circuit breaker opening at a sub-station.

A regenerative system developed by the Jeumont Co. (Ateliers de Constructions du Nord et de l'Est), and tested with results eminently satisfactory on the Metropolitan Railway of Paris, is shown in fig. 3. The control equipment in this case consists of a booster composed of a motor A_1, and a generator A_2, and an exciter A_3, all mechanically coupled, and the exciter serving for exciting the field windings of the main traction motors M_1 and M_2 during the regenerative period. The generator of the booster is used for starting and speed control, the use of starting resistances being thereby rendered unnecessary. The motor A_1 of the booster is connected to the line by means of a starter X in the same way as any other direct current motors. It has a commutating pole winding C, a series winding D, and a shunt winding B. The generator of the booster also has a commutating winding C', likewise the main traction motors, M_1 and M_2. Both these traction motors are permanently connected in series with the generator A_2, but it is possible with the aid of the reverser shown in the lower part of the diagram to reverse the direction of the current in the main motor series windings, and the motors can therefore be made to run in either direction. The generator armature A_2 revolves in a field produced by two field windings, E and F, the latter being separately excited from the supply through a reverser, whilst the winding E is connected across the generator and exciter armatures A_2 and A_3. The exciter armature A_3 also revolves in a field produced by two windings, H and G, the former being separately excited at the track pressure, whilst the latter is connected across the armature A_2. When starting the main motors, M_1 and M_2, the lower reverser contactors are closed so as to give the desired direction of rotation, the field winding of the booster being excited in such a direction that the booster voltage opposes the supply voltage, and the exciting current in this winding is adjusted so that when the contactor P is closed the normal accelerating current passes through the main motors. The traction motors are then accelerated by decreasing the booster's excitation. When the excitation of the field winding F is reduced to zero the voltage across the booster's armature becomes zero, and each of the traction motors M_1 and M_2 (connected in series) receives one half of the total track pressure. At this point the current in the field winding F is reversed, and the voltage of the armature A_2 is so caused to build up in the opposite direction, until ultimately the traction motors M_1 and M_2 each receives a pressure equal to the total line pressure. When it is desired to make the main traction motors regenerate the contactor S is closed, thus connecting the exciter armature A_3 in parallel with the main motor field windings. The field windings of the exciter either act differentially or cumulatively, according to the direction of the voltage generated by the booster armature A_2. In braking from full speed (when the booster is giving its full voltage and assisting the line voltage), the winding G opposes the winding H, and the voltage generated by the exciter armature A_3 is consequently small. But when the booster's voltage is decreased with a view to increasing the braking effect the current in the opposing winding of the exciter diminishes, and the exciter voltage consequently increases, thus decreasing the excitation of the main motor fields. Finally, the excitation of the booster is reversed, when the booster generates a pressure in opposition to the line pressure, and at the same time the current in the winding G of the exciter reverses, thus causing the windings G and H to assist one another. More exciting current therefore flows into the main traction motor fields, which still further increases the braking effect. By the use of the two shunt windings on the booster it is possible to obtain a gradual variation of the voltage generated in the armature with only a few steps in the field rheostat, whilst the two shunt windings on the exciter give automatic control of the excitation of the main traction motors.

THE ELECTRICAL EQUIPMENT OF MODERN SMALL HOUSES.

A JOINT meeting of the Institution of Electrical Engineers, the Electrical Contractors' Association, and the National Association of Supervising Electricians, was held at Caxton Hall, Westminster, on May 27th.

Mr. W. CROSS read a short paper on the above subject, and explained that the primary object of the meeting was to find out the best way to advance the use of electricity in private houses. The principal advantages of its uses were: convenience and adaptability, cleanliness, healthiness, and economy. Labour saving was probably its greatest advantage. The consumption of a 10-roomed house for lighting was only about 300 units per annum; ordinary service conditions were almost equal to test conditions, and there was not the depreciation in lamps or heating elements as with gas or oil. Broadly, there were two classes of consumers: One did not consider capital expenditure if an economical, decorative, and efficient installation was obtained. To secure such a customer good publicity and advice in arranging the installation were required. The other class could not afford large capital cost, and was indifferent about decorative effect or convenience. In that case it was necessary to reduce the cost of the service and installation to the minimum. In suburban houses the lighting service must be conveniently arranged, and the amount of illumination required was more than when 8-C.P. lamps were used. For sitting-rooms, one-light, semi-direct fittings, with half-watt lamps were most popular. In bedrooms there should be two switches, one near the door and the other near the bed. Electric heating was now also usually installed. Electric baths were very convenient, as full heat could be obtained soon after switching on, and the cost of energy was less than that of lighting a coal fire for an hour or two. Baths were usually loaded with 2 or 3 KW., but 1 KW. would be sufficient in many cases. Electric ovens were increasing in use; about 45 units per week would be used for cooking for six persons, the cost being saved by the reduced cost of coal. The thermal efficiency of electricity for water heating and most other thermal processes was extremely high, and electricity would most certainly be used for other purposes than lighting if brought to the notice of consumers. Such appliances as kettles, which would boil water in two minutes (a two-pint kettle using 0.06 unit for that purpose), irons, vacuum cleaners, and buffing machines for cleaning silver reduced the amount of labour very considerably. The apparatus should be let on hire, if the cost was too high for the average consumer, and in most cases it would be eventually purchased. Wiring was very safe if properly carried out; wood casing, closed-joint steel tubing, and screwed steel-tubing systems were satisfactory if carried out in accordance with the Institution Rules. The methods adopted for bonding were, however, in most cases poor. The cost of wiring, in cases where capital cost was of greater importance, could be reduced by the use of metal-covered cable properly bonded and earthed. In many places where lighting only was used, the mains were only earning money for the supplier during a small proportion of the year. In some cases a single cable might be lead from the street to a block of houses, and energy for other purposes than lighting could be supplied at a less charge per unit, as the mains would be in use more fully, and energy used at times other than that of lighting peak load. Where no public supply was available and private plant was installed, the cost was surprisingly low. There should be closer co-operation between supply authorities, manufacturers, and contractors, and the Electrical Development Association could be of great help if it started its publicity work by sending out circulars asking for the support of individual firms and associations.

DISCUSSION.

Mr. J. S. HIGHFIELD agreed with Mr. Cross as to the desirability of all interested in the supply and means of using electricity working closely together. Each branch of the business was entitled to a profit, and each should help the other to get as good a profit as possible. The ignorance of the public concerning the price of electricity was amazing. A tariff should be so framed that energy could be used at any point on the installation for any purpose. The customer should pay a rental plus a uniform low price for units consumed. For the hot-water system it was essential to burn coal, and it was, therefore, their business to recommend and install the right sort of stove. Electrical contractors would get a far greater share of the job of fitting new houses that were to be built if they were in a position to fit everything, not only electrical fittings. They wanted installations as simple as possible, with as few fuses and circuit boards as possible, and the electrical people should be able to give every sort of advice and sell the apparatus as well as dealing with the hot water difficulty.

Mr. W. R. RAWLINGS thought that every house that was built under the new housing schemes should have electric lighting in every room, and also be fitted for electric cooking up to a point. Electricity should not be wasted in trying to boil water. The cost of installing wiring and fittings equalled about eight years' current bill, therefore a man who paid 6s. per week for a cottage (or £30 per annum for a house) on a three-years' agreement would not expend money on wiring and fittings which he would have to leave behind. The installation should be supplied with the current. He thought the Fixed Price Light Co.'s system might be fostered. No meter was used in the house; practically nothing but the lamps and a single-pole switch at the door. One line, with an earthed return, was brought into the house, and the consumer was charged 2½d. per week for light in summer, and about double that in winter. He hoped everyone at that meeting would become a member of the Electrical Development Association; it would do much to cheapen installation work and educate the people in the use of electricity. Many supply companies had no spirit of adventure. He had guaranteed a demand for consumers, because the company required a guarantee.

Mr. PINKNEY explained that with water-heating and cooking installations it might be worth while to have a change-over switch to reduce the maximum demand; a lower charge could be made for cooking if lights could not be used while cooking. It was preferable to hire cookers; if they were bought, and something went wrong, the consumer did not trouble about it. The running of a single cable into blocks of buildings had been found unsatisfactory at Newcastle on account of wayleaves. In the North they expected to get electricity supply in the new housing schemes for lighting, and also for cooking and heating in many cases. On visiting the Model Homes Exhibition he was greatly disappointed to find no electrical exhibits. A company was building a village in his district, and all houses would have electric lighting and cooking. One coal fire would be provided in the living room, which would heat the water. In the sitting-room and all bedrooms there would be electric heating, and in the wash boiler, supplied from the domestic hot-water supply, electricity would be used to raise the water from, possibly, 150 deg. to boiling point. The cost of wiring would have to be reduced, or supply authorities would have to help further with the wiring.

Mr. W. T. REVELL did not see why in a block of houses the supply should not enter at the centre, run up to the roof, and be tapped off with a double-pole switch and fuse on to the first floor. D.O.R.A., or some similar regulation, might be invoked to deal with anyone making trouble about wayleaves. An open wiring system run down the walls in wood casing, with a pair of double-pole cut-outs and a double-pole switch on the landing would meet the case. With the cleated system the wires could be run through the joists, single holes being made for each wire. A low-grade cable could be used, and it was not necessary to bush cables passing through joists. Insulation did not matter, there was always air between them, and where wires ran longitudinally to the joists they could be cleated on porcelain cleats. The system was absolutely the cheapest, and if the Institution would adopt it it would receive the necessary fillip. One cause of the present-day high cost of installation was that they were endeavouring to idealise instead of materialise.

Mr. C. FARADAY PROCTOR maintained that a kitchen grate well constructed would furnish a constant supply of hot water. He had a water cistern 6 ft. horizontally and 5 ft. vertically from the fireplace, and on a recent occasion the house was left on a Friday, and upon returning, on the Monday morning, the water was found to be warm enough for baths. A central heating system would take the chill off the whole of a small house, and radiators could give the finishing touch to the rooms. In the North the cost of a coal fire was about 3d. per room, and 4d. for the kitchen fire. Adding another 1d. to the cost of the kitchen fire for the water heating, that system would be the best for workmen's houses. In an electric oven heat escaped each time the door was opened. This could be avoided by making the oven in the form of a bell, with the elements in the top. To boil an egg, instead of using a pan as big as a hat, a scientific way would be to use a vacuum-jacketed pan slightly bigger in diameter than the egg and heated electrically, which, when once brought to boiling point required no further heat.

Mr. A. J. STIRLING mentioned that he was connected with the wiring of a number of houses on the cleat system 12 years ago; 20,000 lamps were installed which gave every satisfaction, and two men and a boy did the whole of the maintenance work. It would be difficult to get the Board of Trade to permit the earthed wire. He would like to see a standard cable, and suggested that it should be 3/22. It was safer to eliminate flexible as far as possible.

Mr. F. W. MARSHALL thought too much stress had been laid on cheap wiring; the cost of the proposed small house was £450, and that of the wiring about £12 with some of the methods suggested. The more flexibles were eliminated the better it would be; also, he did not think the cleated system good, or called for on the score of expense. With co-operation between the architect, builder, and wiring contractor, screwed tubing could be installed as cheaply.

Mr. W. ELLERD STYLES was of opinion that installations had always been over switched, and that switching had not been judiciously carried out. He advocated inspection by competent inspectors to eliminate jerry wiring. The suggested cleat wiring shocked him; it lent itself to pilfering, and was hideous, and the builder, who generally paid for the wiring in a modern suburb, would not hesitate on the margin

of ½ per cent. between the two systems. Convenience was required, and the workman now could afford to pay for it. He preferred the Henley and Stannos systems to conduit, and there was also tough rubber-sheathed cable for clumsy workmen, which cost only 20 per cent. more than cleating. He would like the Institution to assist the Contractors' Association in getting the registration of contractors.

Mr. J. W. BEAUCHAMP (Electrical Development Association, communicated) said it was seldom that an opportunity occurred of wiring a large number of houses at the same time in quantity and in a businesslike manner, and at a time when the fabric of the houses was not completed. Generally they had to be content with wiring the houses one at a time, and to find them in quite a completed condition, which involved a lot of extra work. Assuming the case of an average villa, say, £45-£50 a year, same being situated about a mile from the depôt or works of the wiring contractor, it would appear that at pre-war prices some 10 to 15 per cent. of the money paid for labour on wiring houses was expended on "walking time" and the transport of materials to the job, leaving only 85 to 90 per cent. of the labour cost for effective operation within the house. To-day, the percentage lost in this way was of the order of 15 to 20 per cent., owing to the alteration in the working hours. It was obvious that everything possible must be done to reduce the number of days spent on any job of this kind, and to expedite the transport of men and materials to the job; very strong arguments in favour of using some form of mechanical transport for conveying both men and materials. Where an estate or block of houses was being wired a clerk of the works and a hut could be set on the job, stores accumulated, and a great deal of loss avoided. Another point was that the underlying principle of improved wiring systems was to get a larger proportion of the money spent in a factory, and a lesser proportion spent actually in the house being wired, *e.g.*, referring again to the standard villa wired in a simple way throughout with plain pendants, the usual class of material and conduit, and full-price trade union labour, it would appear that the total cost (without overall charges and profits) divided up as follows:—

	1914.	1919.
All fittings and accessories ...	14 per cent.	17 per cent.
Cable	15 per cent.	12 per cent.
Conduit	13 per cent.	17 per cent.
Labour	40 per cent.	41 per cent.
Lamps	18 per cent.	13 per cent.
	100 per cent.	100 per cent.

Thus, although the total cost was almost exactly doubled, there had been no great change in the relative proportion of the cost of the several items. The manufactured fittings, conduit, and the labour were up a little; cable was relatively down a little; lamps also relatively reduced by a substantial percentage. For the reasons above stated, there was no great prospect of reducing the labour cost, excepting where large blocks of houses were being wired at once and better organisation and more division of labour could be brought to bear. But the more they could cut into the labour by handing to the workmen more completely manufactured articles than coils of cable and lengths of tubing, the more they would bring the wiring of houses within the four walls of a factory, and the less there would be to do in the house itself, and that appeared to him to be the guiding principle to which they must look in connection with this matter. Having taken advantage in every way of the regulations, or amended the regulations if possible to admit of simpler and less elaborate wiring, they would then have to look for a wiring system of such a character that the wiring, its covering, and the production of fittings to be used in connection with it, were adapted to one another, and produced in the most finished possible form in the factory, leaving the smallest call upon the skill and time of the workmen to fit them up neatly to the structure of the house. It seemed to him that the percentage of total cost expended on labour, both before the war and now, was very high compared with that obtaining for other accessories of the house, for instance, the fixing of fire grates, hot-water systems and baths. In the case of those fitments the cost of the goods as purchased by the builder was very much higher in relation to the cost of fitting them in the house than was the case with electric wiring.

Mr. A. P. TROTTER, referring to the Board of Trade and the question of earthing, said there was a regulation that a circuit should be earthed at one point only, and for many years that was adhered to, in spite of there being several earthed systems. No supplier cared to put an earth on his mains except at his station, so that he could test his mains. The firm with which he was now connected used Stannos wiring on an A.C. system with the outer earthed. The Board of Trade was appealed to for approval, and he saw that the question of electrolysis could be dismissed, and that the system could be cut up with transformers. After some hesitation it was tried at Egham, and later at other places, with complete success. He was not convinced that it would do for D.C., as there might be electrolysis caused by the out-of-balance current on the middle wire.

Mr. H. J. CASH thought that cheapness could only be obtained by standardisation of articles and methods to reduce first cost. Much could be looked for in the direction of cab-tire sheathing. Flexibles across ceilings were not good; probably the thing to do was to improve the flexibles. C.T.S. flexible would get over the difficulty at the holders. It was up to them now to advise how the whole of the engineering work in a house should be done.

Mr. W. CROSS, in a brief reply, said that although interesting points had been raised, he was rather disappointed, as the discussion had turned on cheap wiring, whereas he had hoped to hear more about heating and cooking. He mentioned that it was safer to put two wires of opposite polarity in the same groove of a wooden casing than in opposite grooves. He had seen a 3-amp. arc cause the wooden casing to become red hot, and yet it did not burn. The great point about electricity in the house, which should always be in mind, was that it was a labour saver.

ELECTRIC FURNACE PRACTICE.

(*Concluded from page 678.*)

Large Electric Steel-Melting Furnaces.

BY VICTOR STOBIE.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS.)

THE wiring diagrams (figs. 11, 12, and 13) give what the author considers to be the best connections for three sizes of furnaces. Fig. 11 is for furnaces up to 6 tons' capacity: two-phase, each phase maintained entirely separate from the other, with one end of each phase connected to separate electrodes above the bath and the other end of each phase connected to separate electrodes embedded in the hearth of the furnace at opposite ends of the furnace to their relative top electrodes. This arrangement gives exactly the requisite bottom heating for small furnaces, and is characterised by the crossing of the currents in the direction of flow through the bath.

Fig. 12 is for furnaces from 6 tons' up to 24 tons' capacity: two-phase, each phase maintained entirely separate from the other, with each end of each phase terminating in an electrode above the bath. Bottom electrodes, whilst essential in small furnaces, are very undesirable in large furnaces.

Fig. 13 is for furnaces above 24 tons' capacity: three-phase, each phase maintained entirely separate from the others, with each end of each phase terminating in an electrode above the bath.

The most favourable shapes for tilting electric furnaces would appear to be: Up to 6 tons: Rectangular in plan and in elevation with a curved bottom. From 7 to 24 tons: Octagonal in plan. Above 24 tons: Octagonal with lengthened back and front walls. Stationary furnaces should always be rectangular, figs. 11, 12, and 13.

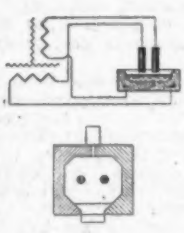


FIG. 11.

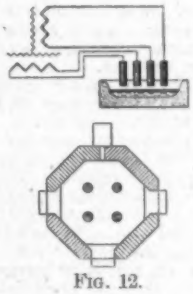


FIG. 12.

The above shapes ensure the most convenient position for the electrodes in the furnace and help to keep the furnace walls at the average greatest distance from the electrodes. It is most essential that electrodes should not be opposite to doors.

Experiments were made at the Stobie Steelworks at Dunston-on-Tyne, near Newcastle, to obtain data as to the cause and effect of the direction of travel of the flame from the electrode. Some control was obtained over the direction of the flame by alterations in the direction of rotation of the magnetic field of the supply currents. A certain change of direction of the flame resulted also from varying the phase reaching each electrode. The extent of the control over the flame was sufficient to make a decided change in the speed of working of a furnace and in the wear and tear of the lining. No definite rule for guidance can be laid down at present, as the matter further depends upon the position of the flames in relation to each other, and, possibly, the magnetic fields external to the melting chamber.

Experiments on the blowing of the arc flames in furnaces by strong external continuous magnetic fields were made in order to eliminate the uncertainty of coincidence of the revolving magnetic fields with some of the arcs in the polyphase systems of electric furnaces. Powerful lifting electromagnets were used for this purpose. Again, the many other factors existing within the arcing zones prevented any definite rule from being framed; but by a careful disposition of the electrodes and cables in an installation so as to cause the

magnetic fields coincident with certain arcs to blow the arcs in a desired direction, a most important increase in speed of melting and reduction in wear and tear of furnace lining are undoubtedly obtained.

Recent experience teaches that, so long as a steel is thoroughly deoxidised before casting, only the temperature of casting is of moment.

The requirements in the design of the transformers are: That the current density of both the L.T. and E.H.T. windings shall be low enough to prevent the inevitable overloads from unduly heating up and deteriorating the insulation. The ventilating channels in the windings must be specially well considered so as to provide low resistance paths for the cooling oil without excessive magnetic leakage. That windings shall be braced on all sides. The L.T. windings shall be taped with such material as empire tape, in addition to press-spahn or similar stiff insulation. All clamps, no matter how small they may be, should be anchored to the transformer framework. The whole of the apparatus must be as unyielding to magnetic stresses as mechanical skill can make it. As much as possible of the total reactance required in the whole of the furnace installation should be incorporated in the transformers.

All tappings brought out from the H.T. windings of furnace transformers should be brought away from the central portions of the winding, the complete H.T. winding being divided into two at the mid-point and the tappings bridged across the mid-point to cut out equal portions of each half of the windings when required. In this way the insulation of the end turns of the H.T. windings can be suitably reinforced to withstand any abnormal voltage stress.

On the practical side, useful results have been obtained at the Stobie Steelworks by limiting the current density in transformer windings to 1,250 amp. per sq. in., the induction in the iron to about 12,000 C.G.S. lines, and the temperature rise on continuous full-load to 45 deg. C., measured by the increase in resistance. In addition to pressure-testing at twice the working voltage, an over-potential test at this double voltage is made on the H.T. side, the periodicity being increased to keep down the magnetising current. The L.T.

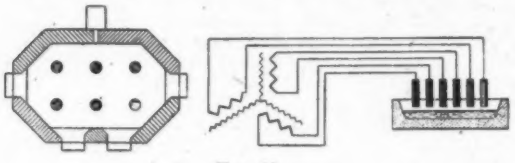


FIG. 13.

windings of large furnace transformers should be tested at a potential several times greater than normal by being connected in series, the L.T. coils almost invariably being designed for parallel working.

If the furnace circuits contain two arcs in series, it is necessary that the energy in each such two arcs should be balanced, whatever current is flowing. This is accomplished in Stobie electric furnaces by operating one electrode motor by an automatic current controller and the other by an automatic potential controller. The current controller is adjusted to give the limits of current required, and will keep its electrode at any position at which such desired current will flow. The potential controller is adjusted so that half the phase voltage, *i.e.*, the normal voltage between one electrode and the furnace charge, is maintained on the electrode it controls. The result is that the potential-regulating motor will keep its electrode at the same distance from the molten steel as the current-regulating motor keeps the other electrode, as at that distance the current will be normal and the voltage balanced.

On some electric furnaces which the author is building for other steelworks the current regulator is connected to one electrode as in the previous system, whilst the potential regulator connected to the other electrode is operated as follows:—

A shunt from each electrode to the bath is passed through separate solenoids placed side by side. An armature in the shape of a bar suspended by the middle hangs over the two solenoids. When the pull of one solenoid exceeds that of the other, one end of the bar is pulled down on to contacts which operate, through contactor switches, the electrode motor in one direction. When the voltage is greater on the other solenoid, the other end of the lever is pulled down by that solenoid, and the electrode motor is operated in the opposite direction.

The total impedance at the moment of starting a large furnace with poor scrap sometimes reaches over 90 per cent. With average scrap it ranges between 40 and 60 per cent. When melting armour scrap or other clean heavy material it little exceeds the reactance.

A 15-ton Stobie furnace gives the following power factors:—On melting, 0.84; when half melted, 0.85; when almost melted, 0.87; when melted, 0.93.

The average (in relation to the magnitude of the load) power factor over the total of units consumed at the Stobie Steel Co.'s works, including all motors for fitting shop, cranes, furnace auxiliaries, and the furnaces themselves, varies between 0.86 and 0.88. The furnace load is about 90 per cent. of the total load, and the balance is taken by intermittent lightly-loaded low-power-factor motor circuits. Large furnaces give an average power factor of fully 0.88 over all units consumed.

It has been stated that furnaces can be worked safely at almost unity power factor. Sooner or later one hears of the collapse of some part of such gear due almost certainly to serious current surges. Experience teaches one to aim for safety before unnecessarily high electrical performance, and this rules out of consideration furnace installations with less than 20 per cent. impedance voltage when short-circuited across the electrode terminals. The author aims at installing plant in such a manner that on dead short-circuit the power factor is momentarily reduced to 0.4 or even 0.3. This need not mitigate against the excellent normal power factors already mentioned.

The following table gives the comparative data of both types of electrodes, including the diameter of electrode sufficient to carry, in practice, 10,000 amp. safely:—

	Specific resistance per cm. cube.	Lowest temperature of combustion.	Diameter to carry 10,000 amperes.
Amorphous	0·00332 ohm.	513° C.	12 in.
Graphite	0·00114 „	624° C.	20 „

Graphite electrodes have not, in the author's opinion, progressed among electric furnace users so well as they would have done had unsupportable claims not been made in their favour. A very important point, almost invariably overlooked, is "skin effect." The early users of graphitic electrodes obtained their experience on non-ferrous furnaces using direct current. The average current density in the main current-carrying area of an electrode in an A.C. steel furnace is roughly twice the average current density of the whole area, due to skin effect, the electrode will not usefully carry as heavy a total current as is generally claimed. This same phenomenon will attain considerable importance in other parts of large furnace plant and lead to great loss of energy and materials, unless studied in detail.

At first sight it may seem a simple matter to close up the clearance between the roof of a furnace and the electrodes passing through it. The difficulty has now been successfully overcome. Observations showed that at about 2 ft. above the roof in most furnaces the electrodes, even when raised for charging, are seldom at a temperature at which they can burn; therefore, that is the only point at which a permanently good seal can be made round the electrodes.

In practice, a light metal cylinder a few inches larger in diameter than the electrode and about 2 ft. in length is fixed on the roof round each electrode. The top end of the jacket is covered with a sealing plate, which prevents the passage of the flames, the electrode passing through a neatly fitting hole in the centre of such cover. Fig. 14 illustrated the apparatus. K and L shows the same principle of economiser in telescopic form suitable for furnaces having only a short electrode

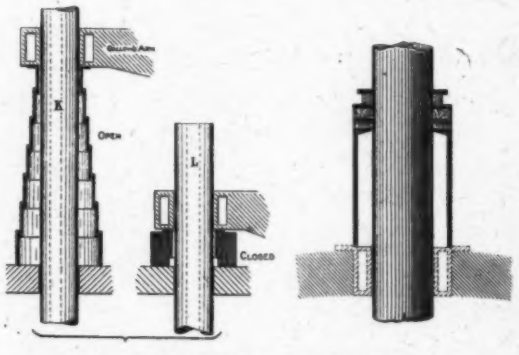


FIG. 14.—STOBIE ELECTRODE ECONOMISERS.

travel. The effect of current regulation is that the electrodes are moved an average of once each 5 to 10 seconds during the first third of the process, an average of every half minute during the second third, and an average of every minute during the last portion of the process.

A careful research on the subject of circulation has been carried out at the Stobie Steelworks, and the results are of interest.

It was decided to devise means whereby closer observation of the effects of electric circuits through molten metal could be made than was possible in a steel furnace working at temperatures up to 1,800 deg. C. Mercury presented itself as a suitable substitute for a hot steel bath, as it resembled molten steel in being a liquid metal and magnetically inert. The resistivity of mercury at atmospheric temperature is approximately two-thirds that of molten steel. Its specific gravity is twice that of molten steel.

Separate experiments with single-, two-, and three-phase currents, and representing every known type of furnace with arcs playing on the bath, were made. The size of the bath, the quantity of mercury, and the current flowing were proportioned to represent average practice, but on a reduced scale. Two voltages were separately used for each system of connections: one low enough to enable the full current to be passed through the bath without arcs, and a higher one to

pass the current through arcs above the bath as in normal steel melting. All the different furnace systems exhibited the same effects when current was switched on.

At low voltage, with the electrodes immersed in the metal, the observed motion of the bath consisted of a very faint pulsation coincident with the periodicity of the current. The amplitude of the pulsation was greatest near each electrode, and diminished with distance according to the law of inverse squares. These vibrations which originated at each electrode were so small that they were detected at the surface only by the minutely throbbing reflection of incident rays. There was no trace of a circulating or swirling motion in any part of the molten bath.

As solid conductors heavily loaded with alternating current always vibrate, it was considered that the minute waves observed in the mercury bath might originate from the vibration of the electrodes immersed therein, and not from the passage of the current through the liquid metal, in consequence of the much greater area of the latter. Therefore the current was next made to flow round entirely-insulated copper circuits immersed in the bath. The same types and strength of electric current were employed as in the previous experiments. Exactly the same pulsations were noticed at the surface of the bath, and a total absence of flowing motion.

The flowing movement of the slag under the arcs, visible in an electric steel furnace when the bath is covered with a fluid slag, has doubtless given rise to the common belief in a stirring of the metal bath by the current. The movement in the slag results, however, from the blowing action of the electric arcs, and it will stop immediately if the electrodes be lowered into the slag.

During the course of the above experiments it was noted that the greatest pulsating disturbance of the mercury was when the arcs played directly upon it. That disturbance was purely local, and diminished considerably when a highly conducting fluid "slag" was placed on the metal. The violence of the blowing action of an alternating arc on liquid metal is observed in a commercial electric furnace if an arc is struck on to the bare steel after the removal of the slag. The steel will be blown away downwards from the electrode end, and, on rebounding, will usually short-circuit the arc. The addition of a fluid slag will relieve the metal of the disturbance, as the slag will take up the flowing effort. The research conclusively proved that no circulatory or other stirring movement of the bath results from the electrode circuits in an electric arc furnace. The more or less complete diffusion of added elements which takes place in a bath of molten steel is a metallurgical phenomenon that occurs in all steel-melting furnaces, whether electric or other, and does not depend upon magnetic or convection currents. No special conditions exist in any electric arc furnace which will relieve the good steel melter from the necessity of properly rabbling his furnace bath.

Application of Electrical Energy to the Melting of Metals.

BY H. A. GREAVES.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS.)

SOME years ago, in collaboration with Mr. Etchells, the author discovered an electrical law which enables three- or two-phase current to be applied to a furnace with an unequal resistance in one of the phases and still maintain a truly balanced load as regards both power and power factor on the primary phases. The connections of such a furnace are shown for three- and two-phase working in figs. 15 and 16 respectively, the length of o c being determined by the resistance of the furnace hearth.

It may be of interest to know that an arrangement, as shown in fig. 17, with an unequal primary star and an unequal secondary delta connected to the furnace will give a truly balanced primary load when the two electrodes are carrying

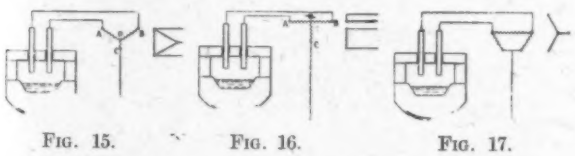


FIG. 15. FIG. 16. FIG. 17.

equal currents, the transformer ratios varying according to the relative resistance of the furnace hearth to that of one of the arcs.

With the systems shown, each electrode is independent and regulation of the electrodes, either automatically or by hand, is perfectly simple, while the heat generated in the hearth of the furnace maintains the metal in constant circulation. These systems also give an extremely steady load on the primary phases, due to the buffer effect of the resistive hearth and the phase displacement caused by short-circuit currents.

Up till recently furnaces of the bottom-connection type have not been operated with an acid lining, as such a lining is considered to be non-conductive, although one furnace is made with a water-cooled stud in the hearth to maintain contact with the charge. Water-cooling in the hearth of an electric furnace is surely a dangerous and inefficient makeshift. A conductive acid lining has been discovered which has operated satisfactorily for some months, and this invention, full particulars of which the author is unable to give at present, will also solve the main difficulties in regulating top electrode furnaces when operating "acid."

A number of furnaces have been built where the full load of the transformers cannot be obtained owing to the drop in power factor with an increase of current, and it has been found in practice that the full-load current per electrode on a 50-period circuit should not exceed 8,000 to 9,000 amperes.

For furnaces of 5 tons' capacity with transformers of 1,300 K.V.A., two-electrode furnaces are satisfactory, but above

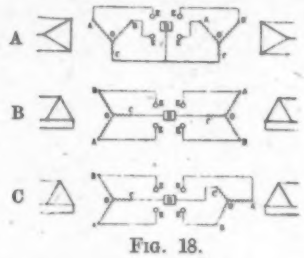


FIG. 18.

that size three or, preferably, four electrodes should be used. Fig. 18 shows three combinations of the transformer system illustrated in fig. 15, E, E, E, E representing the four upper electrodes and H the hearth. In fig. 18A the current transmitted by the hearth when the electrodes are in equal adjustment will be approximately 0.7 times the sum of the currents in the four electrodes; in fig. 18B the current transmitted by the hearth will be nil, and in fig. 18C it will be approximately 0.35 times the sum of the currents in the four electrodes.

It is possible by suitably connecting the voltage-changing switch to arrange for different degrees of bottom heating effect for the different stages of each heat, the best circulating effect being necessary, of course, when the metal is molten and alloy additions are being made to the bath.

ELECTRICITY SUPPLY IN N.E. LONDON.

A PRELIMINARY report has been submitted by Mr. E. M. Lacey, M.I.E.E., on a proposed joint scheme for electricity supply, to the Electricity Committees of West Ham and Poplar. Mr. Lacey estimates that the probable increased consumption in the area considered would justify the erection of a power station designed for 90,000 KW., and capable of extension to a total capacity of 400,000 KW. The most suitable site is at Dagenham, where plenty of space is available on the bank of the Thames; for circulating water 8,000,000 gallons an hour would be required for 90,000 KW., and the pumps would be erected on a ferro-concrete jetty. An existing jetty would provide for the delivery of sea-borne coal, by vessels up to 5,000 tons. Ashes could be largely used for making up adjacent low land, but the bulk would have to be tipped or barged out to sea. By using them for raising the level of 100 acres of land near the site, a profit of £500 per acre could be made, which would more than cover the cost of depositing the ash.

The generating sets would be five in number, of 18,000 KW. each, with an auxiliary set of 1,000 KW. The cost of sea-borne coal is taken at 30s. per ton. The system of generation would be three-phase, at 50 cycles. There would be 20 boilers, with superheaters and economisers, rated at 54,000 lb. each per hour, at 315 lb. per sq. in., and provided with steel chimneys fitted with forced and induced draught. The steam temperature would be 700 deg. F.

The transmission pressure would be 33,000 volts, and the trunk mains would have conductors of 0.15 sq. in. cross-section; each cable would carry 7,278 KW. at 0.85 power factor. The average distance of transmission is 7.5 miles.

The station load factor is taken as 40 per cent., and the coal per watt-hour to the 33,000-volt feeders at 21 B.TH.U.; the annual output to feeders is 252,500,000 units, and allowing for 6.1 per cent. loss in transmission and transformation to 6,600 volts at sub-stations, the annual output to sub-stations at 6,600 volts is 237,000,000. The estimated cost of the power station is given as £1,826,000, equivalent to £20 6s. per KW. of plant capacity; the cost of the transmission line and sub-stations is estimated at £924,000, to deal with 72,000 KW., or £1 14s. per KW.-mile. Taking interest at 5 per cent., and coal at 30s., the annual expenditure for the power station is £493,000, or 0.499d. per unit at sub-stations, of which coal accounts for 0.303d.; the cost of transmission is £69,644, or 0.081d. per unit, making a total of £506,264, or 0.58d. per unit sold at sub-stations.

A table is given in the report, showing the cost per unit at load factors from 20 to 90 per cent., the cost ranging from

0.852d. to 0.394d. The details of capital expenditure are as follows:—

	£
Buildings, foundations, roads, &c.	310,000
Twenty boiler units	410,000
Coal and ash-handling plant and bunkers ...	80,000
Feed pumps, heaters, piping	90,000
Turbo-alternators and exciters, &c.	580,000
Switchgear, transformers, &c.	150,000
Land, 150 acres	40,000
Engineering expenses and contingencies ...	166,000
	£1,826,000
Sub-station buildings	36,000
Transmission mains	702,000
Transformers and switchgear	102,000
Engineering and contingencies	84,000
	£924,000

The details of operating expenses are:—

	£	Per unit at sub-station.
Coal, 200,000 tons at 30s.	300,000	0.303d.
Oil, water, waste, stores, &c.	3,000	0.003d.
Salaries and wages	30,000	0.030d.
Repairs and maintenance	23,000	0.023d.
	356,000	0.360d.
Capital charges on £1,826,000 ...	137,000	0.139d.
Total for power station	£493,000	0.499d.
Transmission: Salaries and wages ...	4,500	0.005d.
Repairs and maintenance	9,000	0.010d.
	13,500	0.015d.
Capital charges, 5.8 p.c. on £968,000 ...	58,878	0.066d.
Total for transmission	£69,644	0.081d.
Total for generation and transmission	£506,264	0.580d.

It will be noticed that there are discrepancies between some of the figures; these occur in the original report.

NEW PATENTS APPLIED FOR, 1918.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS SEPTON-JONES, O'DELL AND STEPHENS (successors to W. P. Thompson & Co., of London), Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

13,152. "Semi-automatic telephone systems." T. PETTIGREW & SIEMENS BROS. & Co. May 26th.

13,161. "Emergency system of relighting electric tramcars and connecting pulleys with overhead wires." A. GARNER. May 26th.

13,169. "Fool-proof fuse switch." G. ANDRE & R. POLLEFEYT. May 26th.

13,172. "Automatic and semi-automatic telephone systems." L. C. BYGRAVE. May 26th.

13,175. "Electric cable junction boxes, &c." SIEMENS BROS. & Co. AND H. G. WOOD. May 26th.

13,181. "Electric replaceable fuses." M. H. GOLDSTONE & J. LIGHTFOOT. May 26th.

13,189. "Microphones." J. NEALE. May 26th.

13,191. "Fusible electric cut-outs." A. C. SMITH. May 26th.

13,196. "Electric lighting systems using low-tension single-phase alternating-current generator." R. BUTLER, J. SANDERSON & G. A. WINSBORROW. May 26th.

13,198. "Electric step-by-step signalling apparatus." B. E. D. KILBURN (Ford Instrument Co., U.S.A.). May 26th.

13,199. "Radio-signalling systems." BRITISH THOMSON-HOUSTON Co. (General Electric Co., U.S.A.) May 26th.

13,201. "Electric fires." H. H. BERRY. May 26th.

13,247. "Process for continuous production of copper wire by electrolytical methods." S. O. COWPER-COLES. May 26th.

13,267. "Attachment of electrical apparatus, instruments, &c., on mechanical-propelled vehicles." J. GIBSON & W. H. WEAVER. May 27th.

13,290. "Sparking plug." W. U. R. GOREHAM. May 27th.

13,298. "Electrically-heated coverings." A. NEGROMANTI. May 27th.

13,317. "Electric transformers." J. W. HOWARD, L. D. MORPHEW AND SIEMENS BROS. DYNAMO WORKS. May 27th.

13,328. "Radio-signalling systems." BRITISH THOMSON-HOUSTON Co. (General Electric Co., U.S.A.) May 27th.

13,353. "Electric conductors and methods of sealing same in glass bulbs, &c." G. CALVERT. May 27th.

13,362. "Telephone systems." W. J. MELLERSH-JACKSON (International Callophone Corporation, U.S.A.). May 27th.

13,391. "Electric impulse controlling devices." AUTOMATIC TELEPHONE MANUFACTURING Co. (Automatic Electric Co., U.S.A.) May 27th.

13,409. "Telephones." J. H. T. ROBERTS. May 28th.

13,428. "Electric bells." H. L. TODD. May 28th.

13,435. "Sparking plugs." T. MORGAN. May 28th.

13,442. "Instrument for indicating electrically whether net, &c., is at assigned depth of water." H. J. BUCHANAN-WOOLASTON. May 28th.

13,447. "Sound-signalling devices." L. CHOLLET. May 28th.

13,453. "Electric switches." V. E. JOYCE & PARK ROYAL ENGINEERING WORKS. May 28th.

13,455. "Electric gramophone mechanism." J. S. BRADSHAW. May 28th.

13,479. "Signalling systems." BRITISH THOMSON-HOUSTON Co. (General Electric Co., U.S.A.) May 28th.

13,482. "Device for converting ordinary clock into electric alarm clock." H. E. VINE. May 28th.

13,485. "Electric storage battery." FULLER'S UNITED ELECTRIC WORKS AND D. A. PALMER. May 28th.

13,488. "Electric signalling lamp." W. T. COULSON & OPTALITE, LTD. May 28th.

13,494. "Oil-immersed water-cooled electric transformers." W. LULOPS. May 28th.

13,498. "Safety relays for starting and regulating apparatus." ALLMANNA SVENSKA ELEKTRISKA AKTIEBOLAGET. May 28th.

13,503. "Electric chain welding machines." G. J. ARMSTRONG. May 28th.

13,510. "Electron valves." CONNECTICUT TELEPHONE & ELECTRIC Co. May 28th. (U.S.A., August 8th, 1918.)

13,512. "Distributor devices for ignition apparatus." REMY ELECTRIC Co. May 28th. (U.S.A., April 4th, 1917.)

13,521. "Electromagnets." G. H. BRYANT, T. M. INMAN & RELAY AUTOMATIC TELEPHONE Co. May 29th.

13,533. "Radio signalling apparatus." MARCONI WIRELESS TELEGRAPH Co. May 28th. (U.S.A., July 12th, 1918.)

13,536. "Switch contacts for multiple switches." R. L. MURRAY & TELEPHONE MANUFACTURING Co. May 28th.

13,537. "Sparking plugs for internal-combustion engines." L. MACQUAIRE. May 28th.

13,552. "Electric control gear for dynamo-electric machines." R. H. BARBOUR & J. R. WALTON. May 29th.

13,581. "Electric heating apparatus." A. BERTHIER. May 29th.

13,582. "Electro-pneumatic braking apparatus." WESTINGHOUSE AIR BRAKE Co. May 29th.

13,587. "Adjustable supports or brackets for carrying electric lamps." H. M. MACNAUGHTON-JONES. May 29th.

13,635/6/7/9. "Coil-winding machines." IGRANIC ELECTRIC Co. & S. R. WRIGHT. May 29th.

13,628. "Applying insulation of high-tension coils." IGRANIC ELECTRIC Co. AND S. R. WRIGHT. May 29th.

13,634. "Amplification of electric currents." BRITISH THOMSON-HOUSTON Co. (General Electric Co., U.S.A.) May 29th.

13,663. "Magnetic cores and method of making same." B. AMES. May 29th.

13,664. "Magnetos." B. AMES. May 29th.

13,665. "Electric generators." B. AMES. May 29th.

13,666. "Electric coils." B. AMES & P. J. GILINSON. May 29th.

13,667. "Electric condensers." B. AMES & P. J. GILINSON. May 29th.

13,673. "Devices for attachment of electric conductors to insulators." F. H. KREBS. May 29th.

13,678. "Increasing power factor in alternating current-apparatus on three-phase systems." H. A. L. BARRY. May 30th.

13,693. "Plug and socket for connecting electric lighting, heating, &c., apparatus to wiring installation." F. W. COOMBER & R. SMITH. May 30th.

13,697. "Permutation switch-lock for connecting or disconnecting electric currents." T. A. HARMER. May 30th.

13,714. "Sparking plugs." K. SMITH & J. WALKER, LTD. May 30th.

13,738. "Automatic or semi-automatic telephone systems." AUTOMATIC TELEPHONE Co. (Automatic Electric Co., U.S.A.) May 30th.

13,739. "Telephone and telegraph systems." AUTOMATIC TELEPHONE Co. (Automatic Electric Co., U.S.A.) May 30th.

13,751. "Electric radiators." J. R. QUAIN. May 30th.

13,773. "Telephone systems." G. H. BRYANT, B. B. JOHNSON, RELAY AUTOMATIC Co. & F. M. WARD. May 30th.

13,792. "Ignition means for internal-combustion engines." N. STELL. May 31st.

13,795. "Insulators for overhead telegraph, telephone, &c., wires." E. A. CHANTLER. May 31st.

13,812. "Electric generators or dynamos." R. T. NORTON. May 31st.

13,855. "Lampholders for incandescent electric lamps." H. F. WHEELER. May 31st.

13,857. "Electro-magnetic timing or time-lag device." E. M. COHEN AND STERLING TELEPHONE & ELECTRIC Co. May 31st.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1916.

18,332. FLASH SIGNALLING APPARATUS. O. Lucas. December 21st, 1916. (126,338.)

18,387. DYNAMO-ELECTRIC MACHINES. G. Plaisant. December 22nd, 1916. (126,340.)

1917.

1,050. DETECTORS FOR WIRELESS TELEGRAPHY AND OTHER PURPOSES. T. Harvey. January 22nd, 1917. (126,381.)

1918.

2,033. ELECTRICALLY-CONTROLLED DEVICES. A. C. Heap & A. B. Field. February 4th, 1918. (126,407.)

2,134. REMOVABLE ELECTRICAL FUSE CARRIERS OR CONNECTING DEVICES. British Insulated & Helsby Cables, Ltd., & L. B. Wilson. February 6th, 1918. (126,408.)

2,265. ELECTRICAL HEATING SYSTEMS. Vickers, Ltd., R. J. A. Pearson and C. R. Mathews. February 7th, 1918. (126,409.)

6,243. DRIVING COUPLINGS FOR MAGNETO-ELECTRIC MACHINES. M-L Magneto Syndicate & C. E. Hulse. April 12th, 1918. (126,426.)

7,364. ELECTRIC MOTOR STARTERS AND CONTROLLERS. E. Schattner & J. R. Walton. May 2nd, 1918. (126,433.)

7,513. INSULATOR CARRIERS FOR OVERHEAD TELEPHONE AND LIKE WIRES. H. W. Laxton. May 4th, 1918. (126,440.)

7,514. METHODS OF CONNECTING TUNGSTEN FILAMENTS TO ELECTRICAL CONDUCTORS. British Thomson-Houston Co. (General Electric Co., U.S.A.) May 4th, 1918. (126,441.)

7,888. ELECTROMAGNETIC DEVICES FOR USE IN SIGNALLING CIRCUITS. J. J. Ghegan. May 10th, 1918. (126,470.)

8,094. ELECTRIC FILAMENT LAMPS. A. Copelin & Edison Swan Electric Co. May 14th, 1918. (126,483.)

8,538. APPARATUS FOR REGULATING THE STRENGTH OF ELECTRIC CURRENTS FOR MEDICAL PURPOSES. M. Nicoletis. May 22nd, 1918. (126,493.)

8,664. MULTIPLEX TELEGRAPHY. F. J. Mackenzie. May 24th, 1918. (126,498.)

9,023. ELECTRIC TORCHES. F. J. J. Gibbons & Efandem Co. May 31st, 1918. (126,504.)

11,628. ELECTRIC CORD PROTECTOR. C. R. Dodge. July 16th, 1918. (126,540.)

14,284. ELECTRIC LAMP AND SWITCH HOLDER. A. P. Rutherford. September 3rd, 1918. (Addition to 116,239.) (126,552.)

17,829. CONTACT BREAKER AND PIVOT BEARING THEREFOR. W. Finch. October 31st, 1918. (126,572.)

20,189. IGNITION SYSTEMS FOR INTERNAL-COMBUSTION ENGINES. A. H. Midgley & C. A. Vandervell & Co. June 5th, 1918. (Divided application on 9,282/18.) (126,583.)

20,576. PROTECTIVE ARRANGEMENTS FOR ELECTRIC DISTRIBUTION SYSTEMS. Electrical Improvements, Ltd., P. V. Hunter & J. R. Beard. December 11th, 1918. (126,584.)

1919.

1,971. ELECTRIC CLOCKS. N. Collins & A. G. Wallis. January 27th, 1919. (126,590.)

2,130. ELECTRICAL DISCHARGE GAP APPARATUS. British Westinghouse Electric and Manufacturing Co. February 8th, 1918. (123,064.)

3,252. DEVICES FOR VARYING THE POINT OF IGNITION IN ELECTRICAL IGNITION APPARATUS. Scintilla. February 9th, 1918. (123,315.)